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TECHNICAL GRADUATES.

Elsewhere is given the result of a census of the universities, colleges and technical schools of this country, instituted in order to obtain data as to the number of students enrolled in electrical engineering courses during the past scholastic year, and the total number of graduates to date from the time the first fledgling electrical engineer issued from the academic shades into what at the period was an extremely unsympathetic world. As will be seen from the tabulation, the number of students enrolled was little short of 9000, the graduates in June numbered 1358, and the total number of graduates to date has reached, in round numbers, 11,000. Lack of previous data prevents comparisons with former years, but it can safely be assumed that instead of high-water mark being reached, the immediate future will show large increases in the number of students enrolled and in the number graduated. The returns show a considerable number of schools, particularly in the newer states, which have only recently organized electrical engineering courses that will require some time for development, and the avidity with which graduates have of recent years been sought by manufacturing companies, and lately by operating companies, must have had an effect in rendering the promise of an electrical course attractive to the budding youth and the fond parent.

The magnitude of the figures we print may cause uneasiness to those who fear that the influx of graduates is greater than the absorptive capacity of the electrical industry. If the graduates were only fitted for purely technical careers, there would be cause for real alarm as the actual requirements in this line could any year be supplied by a small percentage of the graduates. In point of fact, however, we doubt if the schools are turning out nearly as many men as could be utilized with benefit to the electrical industry and with profit to the graduates. It seems now thoroughly established in the electrical field, and is becoming recognized in other industrial fields, that the technical graduate is ideal raw material from which to recruit every branch of an industry; that if taken at the plastic stage upon entry into the work-a-day world, he can be shaped, almost at will, to fill any position in the electrical industry, technical, administrative, manufacturing or commercial. In the day when both the graduate and the public considered a degree a certificate of ability to practice a branch of engineering in all of its details, the employer never thought of the holder of a sheepskin in connection with other duties than merely technical ones. In time, however, it was found that the training of the sound judgment which really constitutes the engineer took time, and that in the same period the graduate could not only be equally well qualified for the duties of any non-technical branch of the industry, but more quickly and more efficiently qualified than young men not technically educated.

In other words, it was found that the mental training and discipline of character received in the schools are of the highest

practical value in life entirely aside from the technical bearing of the studies pursued; and, moreover, that technical knowledge is constantly of value in enabling commercial manufacturing, and, in fact, all non-technical situations of an industry to be grasped more confidently and more firmly. The electrical schools are thus rapidly becoming the sole avenue to the positions of profit and power in the industry. This is already true with respect to the manufacturing branch, and the movement appears to be gaining strength progressively in the central station and electric railway branches. Any fear as to the schools at the present time over-supplying the market for technical graduates is, we believe, groundless.

The I. E. S. Convention.

The first annual convention of the Illuminating Engineering Society is a milestone in the progress of a new art. It is altogether astonishing that so little attention had been paid until within a few years to the proper utilization of artificial light and the new society seems actually to have found and filled a long-felt want in bringing together the men who are directly interested in proper illumination. The trouble heretofore has been that the engineering of illumination in so far as it has existed at all has been merely a neglected branch of something else. Possibly the electrical side of the matter has been better developed than any other, but though electrical bodies have met and passed resolutions about illumination, they have carried no weight whatever because they represented merely the electrical side of the question and rightly or wrongly were under suspicion of self-interest. The Illuminating Engineering Society as a whole has no axe to grind for the benefit of any especial illuminant. The list of papers announced for the convention next week covers a wide range of topics. Of the 17 papers promised less than half are purely on the side of electric lighting, the rest being devoted to other illuminants and to the general problems of the art. Illuminating engineering covers a much broader ground than electric lighting, although to-day electricity is, of course, the chief illuminant in large installations.

It is high time for this subject to take a place in engineering education and especially in the higher schools of technology and of architecture. We are not aware of a single course in illumination given to students of architecture anywhere in the world, although the architect above all others is the man who has to deal with it most frequently and during the only stage at which proper provision can be made for it. The modern city is rapidly becoming an advocate of the 24-hour day and its night conditions are of very great importance. Hence its aspect and efficiency as a nocturnal being must be scrupulously considered. For this reason the art of artificial lighting has assumed an importance during the past ten years greater than it could have acquired in the previous ten centuries. The expert on illumination must have a broader training than if he were dealing merely with gas or electricity or oil, for he must gain a very clear idea of the technical features of all of them and of a good many special matters besides. We know of no technological course yet planned to cover the needful ground, although something is being done in connection with a few electrical courses. We hope the coming convention will help to bring people to a realization that there really has arrived a new branch of engineering and the beginnings of a new profession. When one considers that the expert in illumination often is able to double the efficiency of the illuminating plant, whatever it is, thereby doubling the useful light or halving its cost, the economic importance of the subject is at once apparent. The coming convention should draw a large attendance and should arouse keen interest in the possibilities of improvement. The program is a most promising one even from the standpoint of the layman. The engineers who gather to discuss it form a representative body from all over the country and we trust the Hub to give them a hearty welcome.

Illegal Penalty Clauses.

Some of the recent anti-corporation laws, in various states, especially the laws directed against railroads and seeking to enforce lower rates, have been extreme in their severity; leading already to a marked revulsion in popular sentiment on the subject. It would seem that some of this new legislation is also tainted with illegality, and the decision of Judge Pritchard, of the U. S. Court, in North Carolina this week, is likely to attract an unusual amount of attention, from its strong pronouncement in this respect. The state has passed a low-rate law, inflicting heavy penalties, and under it a ticket agent had been sent to the chain gang. This man the judge has set free on habeas corpus proceedings, declaring the law unconstitutional. Moreover, he pointed out that the penalties inflicted by the statute would close the doors to a judicial hearing and would amount to two and a half million dollars a day if the penalty was enforced on the sale of each ticket, which is eight times more than the amount involved in the original suit; also that it would do violence to the comity which exists between the State and Federal courts. While not imputing any improper motives to officials or State courts, Judge Pritchard remarked that if such conduct were permitted to be pursued it would have the effect of defeating the jurisdiction of the United States courts.

In thus protecting private property against confiscation, the judge has touched points of vital interest to corporations such as those engaged in the field of light and power with rates subject to all kind of dictation from municipal or state edicts and authorities. The rule has a direct bearing, for example, on the 80-cent gas dispute in New York, and is likely to be cited hereafter in other conflicts over public utilities, especially where heavy penalties might be involved capable of bankrupting a company by their enormity. Moreover, as Judge Pritchard remarked: "If the criminal prosecution against the agents, conductors and employees is permitted to continue, the managers of the railroads cannot successfully operate their trains, carry the mails, or continue their usefulness in inter-state commerce."

Spans and Transmission Line Towers.

Until recently, electrical engineering hardly came into contact with structural engineering or bridge building. Now it involves structural engineering not only in the construction of large alternators, but also in tower-construction for transmission lines. A paper on the latter subject was recently read by Mr. D. R. Scholes before the American Institute of Electrical Engineers. It is shown in the paper that if the weight of the

steel in a tower be divided into three items—that for supporting its own weight, that for supporting its load and that for supporting wind stresses—then if the linear dimensions of the tower are varied in any definite ratio the strengths of resistance in each of these ways can be readily deduced without recalculations. Allowing a cost of 4½ cents per pound for the structures delivered in the field, the paper makes the cost of a tower for a three-phase transmission line about $60, the price depending to some extent upon the width of the tower base. Estimates of the cost of the tower line are given which show that the cost of the foundations is about $600 per mile, scarcely affected by the length of span. The cost of the tower structures, if set ten to the mile, is also about $600 per mile, and the cost of insulators $160, making the total cost of the tower line without conductors $1,360 per mile, the towers weighing, each, about 1300 lbs. The cheapest length of span is indicated to be 425 feet, or 12½ per mile. Between 300 and 600-ft. spans, however, the total estimated cost does not vary materially. Beyond 600-ft. spans, the cost of the tower-line increases rapidly, owing to the greater size of the tower rendered necessary, both owing to the greater sag and to the extra stresses. It would be interesting to ascertain how closely the estimates given in the paper are reliable in actual tower-line construction.

TRANSFORMER INSULATION AND TESTING.

With the increase in distances to which electric power is transmitted comes increase in line voltage, and, next in sequence, an increase in insulation of all conductors and windings connected with the lines. In high-voltage transformers, the available winding space has to give so much to insulation that only about 10 per cent can be reserved for the copper. That is, 90 per cent of the winding space has to be occupied either by solid insulation or by oil-ventilating ducts. There is difficulty in providing sufficient insulation for the first few turns of the transformer winding which, being nearest to the high tension lines, are especially exposed to occasional voltage stress due to high-frequency surges. Transmission transformers frequently require to have their ratio of transformation varied at will, by the use of taps to various parts of their windings, so that the extra heavily insulated part connected to the line may have to be changed at different times. This means that a considerable portion of the whole high-tension winding, all told, may have to be re-enforced with extra insulation.

Two papers bearing on this question have recently been read before the American Institute of Electrical Engineers, by Messrs. S. M. Kintner, and Walter S. Moody, respectively. These attack the extra insulation problem of transformers in two different ways. One advocates the use of external choking coils, of highly insulated wire, submerged in oil inside the transformer casing. By this means the high-tension lines always connect directly to the choking coil, which, in turn, connects to the proper tap in the high-tension winding. Thus if the choking coil does its duty properly, the high-voltage waves are rolled back along the line, leaving a smooth, normal voltage level in the transformer, just as a breakwater protects the harbor behind it from the surges due to a distant storm. The advantage of the choke-coil, or electromagnetic breakwater, is that it has no other purpose but to interpose an insulating barrier to high-frequency surges, so that it can be built solely for electromagnetic strength. Moreover, if it should break down under very heavy stress, it is likely to save the transformer winding, and it is then a comparatively simple matter to take out the injured choke-coil and replace it by a new one. The other method of attacking the problem is to make the taps and voltage-changing connections on the inside windings of the transformer—that is, upon parts remote from the ends connected to the high-tension lines. In this way, the extra high insulation is confined to single sections. It is true that these re-enforced sections have to perform breakwater duty as well as generator duty, but the advantage of the plan is that the reactance and regulating defect of separate choke-coils are avoided, while the connections are simpler, and space is saved. Each of the above two methods has its particular advantages that apply with special force in individual cases. It would seem likely that for ordinary service, where the pressures to be expected are not excessive, the locally re-enforced insulation on the transformer ends would be preferable, whereas, in cases of the highest working stresses and of greatest danger, the separate choking coil would be more suitable.

A paper by Mr. H. W. Tobey, on transformer testing under the most recent conditions, cites nine specific tests to which transformers may be subjected under routine in the factory—namely, conversion, polarity, resistance, copper-loss, core-loss, regulation, high-potential, high-voltage and temperature rise. At first sight, there seems to be no difference between a "high-potential" test, and a "high-voltage" test and, in fact, these names are ill selected since they require definition with respect to their distinctions. The high-potential test is a dielectric test of the insulation between primary and secondary windings or between either and the core, and the high-voltage test is a dielectric test made with over-excitation, so as to increase the generated voltage in the windings, and thus to test the insulation of different layers or different turns in each layer. The paper gives a curve of dielectric strength of a certain sheet insulation as measured between two opposed brass disks, by observing the time of break-down under different impressed voltages. The curve represents roughly a variation of voltage inversely as the sixth root of the time between the limits of one minute and one hour, so that the insulation stood 65 kilovolts for one minute and 32 kilovolts for 64 minutes; that is, the voltage that could be sustained fell to ½, in 2^6 minutes. It is not safe to assume, however, that this law would apply to all kinds of insulation. The effects of temperature and of accumulation of ionization products are very different, and modify the behavior of the insulation. This fact is pointed out in the paper. The paper contributes a renewed plea for a standard sine wave form of voltage in the testing of transformers, especially for dielectric strength and for core-loss. An instance is cited of a transformer tested for core-loss with two different generators successively, at the same terminal voltage and frequency; but one giving a sine wave and the other a peaked wave. The sine-wave core-loss was 1177 watts with 33.5 amperes of exciting current. The peaked-wave core-loss was only 924 watts with 15.4 amperes. It is well known that a peaked wave of e. m. f. reduces the core loss, but it is not generally known that the exciting current may be reduced to one-half in this way. Nevertheless, it is generally admitted that it does not pay to use such peaked wave forms.

Graduates from Electrical Courses in the United States.

As a considerable diversity of opinion has appeared to exist concerning the number of students who have been graduated from the electrical courses in the colleges and technical schools of the United States, and as inclusive statistics on this subject have apparently never been compiled, the Electrical World, some months ago, took up the task of making such a compilation, the results of which appear in the accompanying tabulation.

A list was first compiled from the report of the U. S. Bureau of Education, including all schools reported as teaching any branch of engineering or engineering science, to which were added the names of schools obtained from other sources. After a careful revision from information at hand, the final list contained the names of 117 schools. Manual training schools were not included, nor colleges and universities teaching electrical theory as part of a course in physics.

To each of the schools on the final list a letter was sent, addressed in most cases to the professor of electrical engineering in person, and accompanied by a blank form, with a request that the form be filled in and returned, together with extracts from the catalogue of the institution giving details of the electrical course taught. Replies were received from all but seven institutions, and references to the catalogues of these showed that none had a course of electrical engineering instruction. The information received from 14 of the schools showed that the electrical course was embryonic or academic in character, or merely formed a subsidiary part of a course leading to the degree of civil, mechanical or chemical engineer, or was an elementary course in connection with manual training.

There thus remained on the list 96 schools which teach electrical engineering, either as an entirely separate branch or as a specialization in mechanical engineering. In the cases of all the latter schools an estimate was obtained from the professor in charge, of the number of students specializing in electrical engineering and of the probable number of graduates who have entered the electrical field.

An examination of the courses developed, as was expected, a very considerable difference in their character. Keeping in view the relative standing of the schools and of their graduates in the electrical engineering profession, a separation was made in three classes, as follows:

In Class I are included the schools of which the electrical courses enjoy the highest standing, which have the completest equipment for teaching and whose degree confers more or less prestige on the graduate. Naturally this list includes many of the schools which early established electrical courses.

In Class II are included all other schools giving courses of electrical engineering which demand the undivided time of the student enrolled, as distinguished from those so organized as to enable the student to carry on a regular occupation while pursuing his studies.

In Class III are included schools which have a regularly organized course in electrical engineering, in which, however, the instruction is quite elementary from the professional standpoint and usually arranged for evening class work.

	Number of Schools.	Students, 1906-1907	Graduates, 1907.	Total Graduates.
Class I.....	24	3,884	588	5,974
Class II.....	61	4,473	639	4,296
Class III.....	11	572	131	689
Totals.....	96	8,929	1,358	10,959

In a few cases included in Class II it would appear, judging from the teaching equipment and character of the courses, that some institutions have organized electrical engineering branches more from a desire to be considered "up-to-date" than with serious intention to build up a high-grade engineering department. In a few other cases the existence of a course, or a success out of proportion with the resources or location of the school to which it is attached, can be traced to the initiative, energy and personality of the one in charge of the electrical instruction, and under a less able or ambitious successor the present success might not continue.

The most striking feature of the returns is the showing of the number of electrical engineering courses organized—the majority quite recently—in the state colleges endowed and otherwise assisted by the Federal Government. The newer states have taken the lead in this movement, and have also been energetic in building up electrical engineering courses in the State universities. In a few years the additions to graduates from these sources will notably swell the annual total. While few of the courses in these at present compare favorably with the courses of the older schools, the spirit which appears to prevail in the new states in favor of professional education will undoubtedly lead to constant improvement, particularly in equipment.

The serious defect, which is characteristic in general of schools in Class II and of not a few in Class I, is lack of preliminary educational preparation as revealed in the requirements for entrance. To supply this lack results in curtailment of the period of professional education; and if not supplied, the graduate is sent forth as material for an "expert" rather than fitted to become a well-rounded engineer.

First Meeting of Nebraska Electrical Association.

The Nebraska Electrical Association was organized at the Lincoln Hotel, Lincoln, Neb., on July 15. The purpose of this association is to further the interests of its members. The membership is by companies and any employee of the company can represent it at the meetings, which are to be held once a year unless an emergency exists. About 20 men were present. This organization includes only electric light and power companies and supply men. No plant or system which is municipal can become a member, owing to the nature and purposes of the organization. Active membership is limited to operating companies. Supply and manufacturing concerns are eligible only to associate membership.

F. A. Nash was chosen temporary chairman. The officers elected for the ensuing year are as follows: T. H. Fritts, Grand Island, president; R. D. Russell, of Fairbury, vice-president; William Bradford, of Lincoln, secretary; E. V. Capps, of Blair, treasurer; E. A. Bullock, of Norfolk, L. J. Schwingel, of Holdredge, and Mr. Crawford, of Ord, executive committee.

After adopting the constitution and electing officers, a short program was presented consisting of the following papers: "Domestic Electrical Appliances," E. L. Callahan; "Nernst Lamps," G. A. Hayes; "Steam Plants," Mr. Johnson. After discussion on these papers, the association adjourned to meet in Omaha next June.

In the evening those who stayed over were entertained by the supply men at an informal banquet.

The following is a list of those in attendance at this interesting first convention of the new body: F. A. Nash, Omaha; H. Honeywell, B. C. Adams, William Bradford, T. B. Mitchell, M. L. Scudder, F. H. Brooks, E. A. Eames, Lincoln; L. E. Watson, Mr. Johnson, Beatrice; E. A. Bullock, Norfolk; C. A. Snider, Auburn; F. E. White, Ashland; L. J. Schwingel, Holdredge; T. H. Fritts, Grand Island; R. D. Russell, Fairbury; B. P. Egan, Nebraska City; G. D. Skinkle, Geneva; J. M. Roberts, York; A. R. Scott, McCook; C. A. Mann, General Electric Company; E. L. Callahan, General Electric Company; A. G. Munro, Nebraska Electric Company; E. J. Sullivan, Nebraska Electric Company; G. A. Hayes, Nebraska Nernst Company; F. S. Wiemeyer, Fort Wayne Electric Works; L. P. Sawyer, Buckeye Electric Company.

The new association already includes 15 operating public utility corporations.

Annual Convention of the Illuminating Engineering Society.

The first annual convention of the Illuminating Engineering Society will be held Tuesday and Wednesday, July 30 and 31, at the Edison Building, 39 Boylston Street, Boston, Mass. As has been noted previously in these columns, the convention will be held during Boston's Old Home Week, July 28 to Aug. 3, throughout which time there will be many events of interest to illuminating engineers. It is suggested by the convention committee that it might be wise for members to arrive in Boston in time to see the electrical parade and carnival on Monday evening, when the city will be decorated and profusely illuminated. For the convenience of those who cannot start earlier, arrangements have been made for a party of delegates to leave New York by the Providence Line at 6 p. m., Monday, July 29.

The following is the preliminary program of papers that have been promised:

Opening address by the president, Dr. C. H. Sharp; Check on the Reliability of Photometric Curves, by J. S. Codman; Electric Light as Related to Architecture, by C. Howard Walker; Acetylene, by A. Cressy Morrison; What Is Street Lighting? by W. H. Blood, Jr.; A New Comparison Photometer, by Dr. Charles H. Williams; Primary, Secondary and Working Standard of Light, by Dr. Edward P. Hyde; The Inverted Gas Lamp, by T. J. Litle; Lighting of the Boston Edison Building, by Dr. Louis Bell, L. B. Marks and W. D'A. Ryan, *Committee;* Illuminating Engineering and Central Station Practice, by L. H. Scherck; New Lamps and New Illuminants from the Central Station Point of View, by R. S. Hale; Coefficients of Diffuse Reflection, by Dr. Louis Bell; School House Illumination, by B. B. Hatch; Illumination of the Engineering Societies Building, by C. E. Knox; The Elements of Inefficiency in Diffused Lighting Systems, Illumination Photometers and Their Use, by Preston S. Miller; The Present Status of Candle Power Standard for Gas, by C. H. Stone, and The Luminous Arc, by W. D'A. Ryan.

It will be noted that the list makes a most attractive program, covering a wide range of topics and laying bare before the members the results of a large amount of original research. Still other papers are expected which will further add to the importance of the convention from the technical standpoint.

Among the special entertainment features may be mentioned the plan to take the entire convention to the beach, on Wednesday afternoon, with a shore dinner for the members, their guests and ladies.

Electrical Decoration Details of Boston Old Home Week.

The electrical decorations for Boston's Old Home Week will probably eclipse the celebrated electrical illumination held in Boston at the 1904 Grand Army Encampment. The electric fountain designed by Mr. John Campbell, chairman of the illumination committee, is rapidly approaching completion in the Frog Pond on the Common. The water column of this fountain will be over 40 ft. high. The base is of concrete and stone of a rustic design, and about 20 ft. in diameter. The fountain shaft will contain nine disks, from which all the colors of the spectrum will be reflected through the water, in any combination desired. Two men will operate the fountain at night and it will remain a permanent feature of the Boston park system. The Edison Electric Illuminating Company has donated $500 toward the cost of the fountain and will supply the energy for its operation free of charge.

The front of the Old State House will be emblazoned with a floating flag of large size. Faneuil Hall will be electrically illuminated, and the Old North Church beacon will be lighted as a reminder of Paul Revere's famous ride. The birthplace of Prof. S. F. B. Morse, on Main Street, Charlestown, will be illuminated by an electrically lighted telegrapher's key, and the electrical display at Ben Franklin's birthplace, on Milk Street, will present his kite and key. The stations of the Boston Elevated Railway Company will also be specially lighted, as will the City Hall, State House, North and South Terminals. Electric Japanese lanterns 3 ft. apart will light the path on the Common which was a favorite walk of Dr. Oliver Wendell Holmes.

Pacific Gas & Electric Company.

The Pacific Gas & Electric Company, of San Francisco, which is a consolidation of the San Francisco Gas & Electric Company and the California Gas & Electric Corporation, the latter controlling the Bay Counties and other power companies, has been strengthened financially through the efforts of the Eastern financiers who purchased a large interest in the system several years ago and have since increased their holdings. An election of officers has recently taken place, changing the personnel of the company in several instances.

Mr. Frank G. Drum has been elected president of the Pacific Gas & Electric Company. Mr. John A. Britton, who formerly occupied that office, is now the vice-president of the Pacific Gas & Electric and the president of the San Francisco Gas & Electric Company, the California Gas & Electric Corporation and of all the other subsidiary corporations. He is also to be general manager of all the companies.

Mr. C. W. Conlisk has resigned the position of secretary of the Pacific Gas & Electric Company. Messrs. John Martin and Eugene de Sable, Jr., who have figured so prominently in these companies since their organization, have retired from active control and have opened up offices, respectively, in the Merchants' Exchange Building and the French Bank Building, San Francisco.

The Pacific Gas & Electric Company is planning several important improvements, which will materially benefit the service. Preparations have been made to install at Station A of the San Francisco Gas & Electric Company, in the Potrero, an additional 5000-kw, 11,000-volt, steam turbine generating set. A 1500-kw generating set is to be removed from the same station to the Pacific Company's steam relay plant at Petaluma. One of the 1200-kw direct-current generating sets from the old Jessie Street station, which has been damaged by three fires in the last 18 months, is being installed in the Mutual Electric Light Company's plant at Speer and Folsom Streets, which is now under the control of the San Francisco Gas & Electric Company. A small storage battery is to be installed in Station C in place of the large one that was destroyed by fire.

The gas system of the corporation is now in good working order in a number of outside cities as well as in San Francisco under the supervision of Mr. E. C. Jones. The largest plant is at Martin Station, six miles south of the city, where there are two 2,000,000 cu. ft. gas-generating units and a 2,000,000 cu. ft. gas holder. These supply the three large Snow gas engines, each direct-connected to a Crocker-Wheeler 300-kw, three-phase alternator. These gas-engine units are kept in operation almost constantly, although they are intended to serve as a reserve plant.

The company's gas business at Sacramento has been growing, and an additional gas holder with a capacity of 500,000 cu. ft. is being constructed there. An additional 100,000 cu. ft. gas generator is also to be installed.

Improvements and extensions are being made at the plants in Fresno, Santa Rosa and San Rafael. A 100,000 cu. ft. gasholder is being erected in the last-named city. The gas business of Oakland and vicinity has doubled since the San Francisco disaster. An additional gas-holder, having a capacity of 1,000,000 cu. ft., is being constructed, entirely above ground, on property near the company's main plant in Oakland. A 20,000-barrel steel oil-tank has been installed at Station B, near the corner of First and Market Streets. This tank was moved from the old Pacific Gas Improvement Company's works at North Beach, San Francisco, on two scows to Oakland. As the big

steel shell is 82 ft. in diameter it was quite an engineering feat to handle it on the waters of the bay.

Owing to the cost of rehabilitation, the rapid extension of its lines, the improvements noted above and incidentally the lowered gas rate in San Francisco, the board of directors of the Pacific Gas & Electric Company, controlling the San Francisco Gas & Electric Company, the California Gas & Electric Corporation and other subsidiary companies, have voted to levy an assessment of $3,000,000 on the stock of its shareholders. The assessment on each share will be $10 on 100,000 shares of preferred stock and 200,000 shares of common. The expenses of the company for the last year and a half are roughly figured at $7,000,000. It was the decision of the board to assess the stockholders rather than borrow the amount.

According to the statements of its officials the cost of rehabilitation has been enormous. In addition has come the enlargement of the company and the building of new power houses throughout the state. A heavy expense has been the purchase of subsidiary companies and the whipping of them into shape to supply the cities of California. Not the least of the company's troubles has been the lowering of the gas rate to the consumers of San Francisco, according to an official announcement made recently.

The majority of the stockholders were represented by the board of directors at its meeting. Fully 70 per cent of the company's shareholders were represented directly or indirectly by the various directors and no complaint is anticipated. The company estimates that $3,500,000 has been expended in San Francisco alone and a similar amount throughout the state, and believes that the stockholders will see the wisdom and necessity for the move.

General Electric Copper Mining.

The General Electric Company is reported to be expending about $1,000,000 in developing and placing its Bully Hill copper property in California upon a producing basis. For a year and a half development work has been progressing without net returns of any moment. It is understood that it has been definitely decided to double the capacity of the Bully Hill smelter, and instead of two furnaces there will be four with reduction capacity of 1200 to 1500 tons per day. Most of the old machinery will be utilized in reconstruction. The old buildings have been torn down, the briquetting plant removed and the McDougall roaster and converters dismantled. President Riordan, who is now in California, says that the whole plant will be reconstructed at a cost of between $300,000 and $400,000. The Bully Hill Company is expending at least $500,000 in the building of 18 miles of railroad connecting its smelting plant at De Lamar with the Southern Pacific about two miles above Kennet. Over 400 men are employed in the construction of this road, of which about 10 miles have been built. It is expected to have the line completed by Nov. 1. It will be called the Sacramento Valley & Eastern, and on Aug. 1 a meeting will be held in California, when the capital stock will be increased from $300,000 to $500,000. It is estimated that this road will effect a saving to the Bully Hill Company of $4 per ton in coke supplies and a pro rata saving on all freight. The wagon road to the Bully Hill mine is 30 miles in length. Within 60 days after the completion of the road, the smelter should be ready to blow in. The Bully Hill should be able to supply 25,000,000 pounds of copper per annum to the General Electric Company at a cost of about 10 cents per pound. On 15-cent copper this would mean an annual saving to the General Electric Company of $1,250,000 and on 20-cent copper $2,500,000. The company's total investment, including the purchase of the property, will probably be in the neighborhood of $2,500,000, so that the General Electric Company may get its total investment back in between one and two years. The copper requirements of this company are said to amount to about 1,500,000 lbs. per week, which is at the rate of 75,000,000 lbs. per annum.

Expert Investigations in Municipal Ownership—II.

In favoring municipal ownership, Prof. Parsons declares that in most discussions of the subject too much attention is given to the purely financial side of the question. "Dollars and cents are not to be neglected," he says, "but life, liberty, justice, virtue and intelligence—the whole character product and social product of our institutions—are of greater moment than their money product." Taking up financial results, Prof. Parsons gives it as his view that the municipal plants are more economical. "Broadly speaking," he says, "recognizing that there are exceptions to all rules, the facts show that municipal plants tend to make lower prices to ordinary consumers than private plants in the same country working under similar conditions, and they do not grant electric rebates or other favors by secret agreement with large users, as is not infrequently the case with the larger companies. In the comparatively few cases where municipal systems do not make low charges the public still gets the benefits that under private operation go to the stockholders, for the profits of the public plants are used to improve the service, pay off the capital, relieve taxation or accomplish some other public purpose. Municipal plants are found, as a rule, to have a lower capitalization than private plants, both in relation to output and in relation to assets."

Discussing so-called failures of municipal ownership, Prof. Parsons claims that some of such cases are really failures of private ownership. "Take Philadelphia gas, for example," he says. "It does not appear that Philadelphia ever had real public ownership of the gas works. She had government ownership of gas works. But government ownership is not public ownership unless the people own the government. Philadelphia had the paper title to the gas works, but the people did not own or control them because they did not own the city government. The Councils were full of the agents and allies of the private street railway, telephone, gas and electric light interests and they purposely mismanaged the gas works, allowed them to be filled with supernumeraries and let them get out of repair by refusing year after year to appropriate, even out of the receipts of the plant itself, the money necessary to keep it in order, so that they might have an apparently good excuse for executing a lease of the works to themselves. Philadelphia did not have real public ownership of gas, but one of the worst forms of private ownership—ownership by political grafters, in the pay of corporations, but masquerading as public servants."

Richmond, Va., is cited by Mr. Bemis as a city where a municipal gas plant has not only reduced prices, but has also turned a profit into the city treasury. The city authorities declined, however, to permit a full investigation to be made, saying that a recent investigation had been very unfair. Enough was learned to show that the Richmond plant was free from the spoils system and from graft, and that the workmen were white men who were paid nearly twice as high wages as were the negro laborers in the privately owned works at Atlanta. Mr. Bemis' review of the Philadelphia gas situation is in marked contrast to that of Messrs. Edgar and Clark. Mr. Bemis also quotes Dr. Rowe as authority on the subject, to show that when direct municipal operation began, Dec. 31, 1886, the plant had been entirely paid for out of profits, with the exception of $1,802,948. After including the expenses of collection, maintenance of street lamps, etc., borne by other city departments, the net cash turned into the city treasury during the years 1888-1897 inclusive was $2,937,719.56. To this should be added the amount spent for extensions of the works, mains and services, which is easily computed from Prof. Rowe's data at $4,344,316.92. This would make a total apparent profit during the 11 years of municipal operation of $7,282,036.48. Since this profit was computed after including the operating expenses, and the expenditures for repairs of 8 cents to 10 cents per 1000 cu. ft. a year, the depreciation could not have eaten up any large part of this apparent profit. The price of gas was reduced from $1.50 to $1 at the close of 1893. At

first there were deficits, but these rapidly declined. According to Prof. Rowe, there was a net profit during 11 months of city operation in 1897 of $123,915.06, after paying the expenses incurred on account of gas in other city departments.

"By reason of municipal ownership, Philadelphia was able to lease to the United Gas Improvement Company most valuable street mains, land and holders, to say nothing of such portions of its other plant as with moderate repairs could be put in good shape. By asking for no rental or taxes on this plant which had been paid for out of the profits of city ownership, Philadelphia was able to secure a lease under which it received 10 cents per 1000 cu. ft. of all gas sold to private consumers during the first 10 years of the lease, 15 cents during the next five years beginning next January, 20 cents from Jan. 1, 1913, to Jan. 1, 1918, and 25 cents for the remaining 10 years. The city also receives free of charge 700,000,000 cu. ft. of gas yearly for street lamps and public buildings, and the maintenance of those street lamps by the company.

"On the other hand, in New York City during the past 10 years, barring two years of the so-called gas war, 1899-1900, the people have not only paid $1 as in Philadelphia, but they have also paid both for the gas used by the city and for the care and maintenance of the street lamps, while the taxes received by the city and state have not been as much per 1000 cu. ft. as the payment of 10 cents in Philadelphia."

That the municipal electric light undertaking at South Norwalk, Conn., is one of the most successful plants, either public or private, in the United States or Europe is the opinion expressed by Mr. Bemis. The operation of the Chicago plant, also, is commended, the expert quoted by Mr. Bemis estimating the profit to the city on the plant up to the close of 1905 at $710,433. The spoils system has been singularly kept out of the Chicago plant, according to Mr. Bemis, although the plant itself is not all that could be desired. "During the year 1905," continues Mr. Bemis, "the accountants estimated that the cost in Chicago, including interest and depreciation, was $100.06 per lamp as compared with $102.92 per lamp charged by the private companies, but the cost of $100.06 was reached by allowing about $10 per lamp more for the value of water used, and for depreciation than the accountants used in any of the previous years, or than they had found necessary to tally with the measurements of water actually used and the depreciation necessary to reduce the original cost of the plants to their present appraised value. The important point, however, from the standpoint of municipal ownership is that the cost is less per arc than the city is paying for similar lamps from the private company.

"Next to South Norwalk the most successful municipal electric lighting plant has been that of Detroit. If it had been allowed to do a commercial business, its success would have been even greater than has been possible with only the lighting of streets and public buildings. The only criticism of the plant, and that not clearly proven, has been that it was unduly conservative in replacing its open arcs and small generating units with inclosed arcs and larger generating units. Much progress, however, has in fact been made in this direction, and more is being made during the present year. Allegheny, although confined to street lighting, and suffering from the spoils system and a poor location, has nevertheless saved up enough to pay for her plant out of the difference between her operating expenses and the $96 a year which Pittsburg has had to pay for similar arc lamps prior to 1906."

Mr. Bemis closes with a reference to political and labor conditions, which he finds, generally speaking, more favorable under the municipal undertakings. On this subject, he sums up as follows: "In electric light, as well as in water, the municipal employees usually get as good wages as are paid elsewhere in their respective cities for similar work, and also usually work but eight hours, while the employees of the private plants—except in the highest paid positions—never get more, and often receive less, per day than the municipal employees, and sometimes work nine or ten hours instead of eight, that is practically universal to-day in public employment. The Chicago and South Norwalk plants are, and apparently always have been, out of politics. The same is true of the Detroit plant so far as party politics is concerned. In all municipal plants trade union conditions prevail and the majority seem to be members of the union, but those who are not members of labor organizations are freely employed. One exception to absence of politics in the electric light plants is in Allegheny, but here again, as in the Wheeling gas works and the Syracuse water works, or in the Philadelphia gas works, when public and private management existed side by side, the same conditions which permit the spoils system in municipal plants bring private companies into close touch also with the spoils system, and with party organizations and city governments."

Following the sections of the report of the National Civic Federation commissioners on American private and municipal plants, are reports dealing with British municipalities. The preliminary reviews of the experts' reports, written by Messrs. Milo R. Maltbie, Walton Clark, vice-president of the United Gas Improvement Company of Philadelphia, and Charles L. Edgar, president of the Edison Electric and Illuminating Company of Boston, are divided in opinion as to the success of the undertakings as a whole. Mr. Maltbie, whose review is made from the viewpoint of an advocate of municipalization, is one of the members of the newly created Public Utilities Commission for Greater New York. This body has the widest powers and the greatest responsibilities of any commission to which the regulation of corporations has been entrusted, up to this time in the United States. Mr. Maltbie says that municipal operation of public utilities in Great Britain has passed the experimental stage. He declares that of the plants examined in Great Britain, those operated by municipalities in almost every instance gave a superior service at a lower cost, as compared with the privately owned companies. This condition he finds to be due to the higher rate of interest and profit and the greater amount of liabilities of the private companies. By far the most interesting part of Mr. Maltbie's conclusion, however, is that actual ownership and operation is not necessary for the success of the municipal ownership idea. He says that the power to operate, if necessary or desirable, in many instances has been as effective as actual operation—that the mere fact that a city has the power to step in and operate an undertaking itself often makes the exercise of its power unnecessary. "It has been found in Great Britain that no system of control or regulation is complete without the power in the hands of the municipalities to purchase and operate," says Mr. Maltbie. "If one company may be succeeded only by another or only hedged about by restrictions, there come times when action, not repression, is wanted, and then no remedy is adequate unless it be the power of the city to step in and operate the undertaking itself. But the mere fact that it has the power often makes its exercise unnecessary, and what the Britisher desires is not the universal adoption of some method of producing results, but the results themselves.

"In the following analysis of the results of public and private management it should be borne in mind that such a comparison is not a comparison of municipal with private operation subject to no restraining force, but with private operation under systems of regulation which are claimed to be the best which have yet been devised in Great Britain and with private management that has been chastened and bettered by the fear of public condemnation, by the restraint of government regulation and the possibility of municipalization. Thus the low price at which gas is supplied by the Sheffield company is largely the result of the avowed determination of the men in control to head off municipalization. If municipal operation had not been a possible alternative looming above the horizon, it is likely that even now the consumers would be paying very much higher rates; and the present low rates so far as they are due to the desire to prevent municipal operation should be counted as one of its indirect results."

The reasons that have led to British municipalization, Mr. Maltbie finds, are many. First among them, although not the

most general nor the most important, is the desire to secure for the public the financial profits of the undertakings. Second, there is the desire to keep the city from being mulcted by a private company and third, the general demand for better service at lower rates. He mentions, also, a fourth cause, which has played a prominent part in the United States, and which is not unknown in Great Britain, namely, opposition of privately operated public utilities companies to the welfare of the city. A fifth factor has been the belief that municipal operation would permit the co-ordination of public services in a way that is not possible where different services are operated by private companies.

Quite a different view of the subject is taken by Messrs. Edgar and Clark. They favor some form of regulation of private companies rather than the adoption of the municipal ownership idea. Basing their opinions upon the same reports of experts from which Mr. Maltbie draws his favorable conclusions, the other reviewers declare it to be plainly proven that municipal ownership is productive of many and serious ills with little or no compensating good. They hold that the solution of present difficulties is to be found, not in municipal ownership and operation of the public utilities, but in the election of municipal officers who will protect the governed against injustice on the part of individuals or corporations.

The electric lighting plants investigated by the Civic Federation Commission were the municipal ones at Manchester, Liverpool, Glasgow, and the Borough of St. Pancras, London, and those operated by the Newcastle Supply Company, the Newcastle District Company and the four London companies: the city of London, Westminster, St. James and Central. Charges by the municipal plants were more economical, according to Mr. Maltbie, the cities charging .529d. per unit less than charged by the private companies. As to efficiency of service, there was no difference between the municipal and the company undertakings, as regards the promptness with which current was turned on and complaints attended to, the convenience of the location of offices, the testing of meters, the restoration of paving after streets were opened, the care given to street work generally, although there were more complaints upon this score against companies than municipalities the construction of extensions, and the extent to which the entire area of supply was served and appliances carried in stock for sale or rent.

The character and equipment of the plants investigated is discussed. Mr. Maltbie summarizes the result of this branch of the examination, saying it appears that one of the company stations is more modern and efficient than any one maintained by a municipality; but it is also true that two of the companies are more backward and have a more antiquated equipment than any municipality. Upon the whole, the municipal undertakings seem to be as modern as those belonging to the companies, but not so well located or arranged, and perhaps not quite as efficient.

In concluding his review of the reports of the experts, Mr. Maltbie says: "The opponents of municipal activity have frequently tried to scare the British voter and to prejudice him against the operation of public utilities by local authorities by citing the large increase in total indebtedness within the last fifty years, as compared with the decrease of the national debt. They have pointed out that the local debt has more than trebled in the 25 years from 1875 to 1900, and that the amount of local debt per £100 of ratable value of property has doubled in the same period, while the national debt has decreased almost 18 per cent.

"Over 40 per cent of the local debt is for water, gas and electricity works, tramways, markets, harbor improvements, wharves, cemeteries, baths, workingmen's dwellings, etc. In every one of these cases the debt is represented by physical assets. Besides, there are parks, street improvements, school houses, almshouses, bridges and many other investments which are now being used for public purposes and by which the present citizens are being benefited. What does the national debt represent? To a certain extent, public works of present use and value, but principally war expenditures or expenditures to guarantee success in case of war.

"Further, debt for productive undertakings, such as gas works, electricity supply and tramways, has a quite different character from debt for schools, parks, prisons, etc. The latter do not produce a financial return, however necessary and valuable they may be. They may be even more important than electricity works, but the mere fact that they are not self-supporting places them in a distinct class. Their debt is a burden upon the taxpayer, for he must pay the interest thereon as well as the cost of maintenance. But in the case of the three public utilities here considered, it has been thoroughly demonstrated that the interest and fixed charges are paid by users or consumers and that in no instance has the taxpayer been called upon to make up any deficiency, except possibly temporarily, and then he has been repaid at a later time.

"But this is not all. It has been definitely shown not only that the debt is not a burden upon the taxpayer, but that the taxpayer gets a financial benefit from municipal operation, and therefore from the very debt which is claimed to be a burden upon him. It is not evidence, but it is suggestive, that the local rates (tax rates) were lower for every group of towns when there was municipal operation of gas, electricity or trams than where companies were operating."

CURRENT NEWS AND NOTES.

NO STRIKE.—The telegraphers who were threatening strike have become conciliatory all along the line and have decided to accept the terms of settlement offered by the Western Union and Postal companies. As expected, the strike is "all off."

OHIO ELECTRIC LIGHT ASSOCIATION.—The 13th annual convention of the Ohio Electric Light Association will be held at Toledo, Ohio, Aug. 20, 21 and 22, 1907, with headquarters at the New Boody Hotel. The subjects of papers to be read are as follows: Factory Lighting (two papers); Experience in Operation of Luminous Arcs (one paper); Co-operative Commercialism in the Electrical Field (one paper); Best Form of Power for Stations of 500-kw Capacity or Less (one paper); Helps to a Solicitor (three papers); Best Ways to Meet Gas and Gasoline Competition (five papers). In addition there will be reports on results with heating devices; high efficiency lighting units; uniform accounting, and cost determinations. An excellent entertainment will be provided. For the ladies there has been placed at the disposal of the association 25 valuable prizes to be distributed among those who attend. D. L. Gaskill, Greenville, Ohio, is secretary and treasurer of the association.

ELECTRIC GAS ARCS.—According to a London contemporary, electricity is to be employed in connection with a type of the so-called "gas arc lamps." In order to supply enough air for complete combustion—the Bunsen arrangement is not perfect in this respect—a small fan is used, which is driven by an electric motor. Forced pressure systems are not new, of course, but they are not self-contained and they have many drawbacks. In the Denayrouse burner, for instance, electricity was supplied from an external source, but in the present case a thermopile affords enough energy for the purpose. It seems like trying to light a house with Leclanché cells, but is said to work. The hot gases rising from the flame pass over the thermopile, which is arranged in the upper lantern. The motor is vertical and its armature lies between the two mixing tubes. The mixing is claimed to be more thorough than with other types of lamp. When first the lamp is lighted it burns under normal pressure with rather a dull flame. The hot gases in the chimney soon heat up the thermopile, the motor begins to turn, and it is said that in half a minute a speed of 2000 r. p. m. is obtained.

AN EASTERN TRIP.—The members of the board of supervising engineers of Chicago tractions on an eastern tour include Messrs. Bion J. Arnold, chief engineer; Harvey B. Fleming, Chicago City Railway and George V. Weston, assistant chief engineer for the city. They will inspect the Pennsylvania Steel works and the shops of the William Wharton, Jr., Company at Philadelphia, also the Brill Manufacturing plant and the new subway of the Philadelphia Rapid Transit Company and will inspect the New York subway and the new Manhattan Island tunnels.

COPPER PRODUCTION in this country continues on an enormous scale. It reached, in the calendar year 1906, according to figures compiled by the United States Geological Survey, 906,591,947 pounds, an increase of 18,000,000 pounds over 1905. The stock on hand at refineries on January 1 last amounted to 92,470,792 pounds, 25,773,236 pounds less than on January 1, 1906. The consumption of refined copper for the year, including 215,000,000 pounds of foreign copper imported, was 680,000,000 pounds, exceeding that of 1905 by 80,000,000 pounds. The exports for the year aggregated nearly 450,000,000 pounds.

BLOCK SIGNALS.—It is stated that out of a total mileage on the Pennsylvania Railroad's eastern lines of 6032 miles of track, more than 1500 additional miles have within the last three years been equipped with block signals, at a cost of $856,520 to the railroad company, and adding $210,816 to the annual operating expenses. The signal report shows that the company now has every mile of its main lines protected by block signals, and of the entire mileage of the lines east but about 500 miles are not equipped with block signals. Most of the latter, however, are short, industrial lines or branch lines on which the traffic is so light and of such a character as to render the block signal unnecessary.

TWO-CENT TELEPHONY.—It is stated that the Fagan administration in Jersey City, which proposed a municipal street car line with 3-cent fares, is now backing a scheme for a telephone system for which the charges to Jersey City users would be 2, 3 and 5 cents, according to the time consumed in the use of the wire. The proposal has been made by the Atlantic Coast Line Company, a rival of the present telephone company. The 2 and 3 cent proposal met the instant approval of the Fagan reformers, who are now urging the grant of a franchise to the new company on liberal terms. It is said that the company, in addition to giving the citizens the cheaper rate, is willing to install telephones in the City Hall and other departments of the City Government at a merely nominal compensation, and in addition to pay $100,000 for a franchise.

COMPETING TELEPHONE COMPANIES MUST CONNECT.—Judge W. H. Hunt, of the U. S. District Court in Montana, has decided that competing telephone companies cannot withhold the use of their lines from each other. The suit in which the decision was rendered was between the Rocky Mountain Telephone Company, a Bell interest, and the Montana, Wyoming and Mutual Telephone companies. The latter companies had applied to the court for an order compelling the Rocky Mountain Telephone Company to furnish connections when desired at reasonable compensation. This was resisted on the ground that the lines were built for its patrons and not for those of competing companies. Judge Hunt found for the complainants, and stated that within a few days he would name a commission to fix the division of charges when such use is made of connecting lines.

LIMITING HOURS.—At Albany, N. Y., on July 20, Gov. Hughes signed the bill of Assemblyman Northrup regulating the hours of labor of block system telegraph and telephone operators and signalmen on surface, subway and elevated railroads. The measure provides that it shall be unlawful for any such corporation to permit any telegraph or telephone operator whose duties pertain to the movement of trains by use of the telepraph or telephone, to be on duty more than eight hours in a day of 24 hours. In cases of emergency the rule may be broken, but extra compensation must be given. Violations of the act are punishable by a fine of not less than $100, one-half to be paid to the informer and the other half to the school fund of the state. The act takes effect on Oct. 1. It was shown in the arguments in support of the measure that many men upon whose alertness the safety of thousands of passengers depended were compelled to work 12 and even 16 hours a day.

BRYAN ON OWNERSHIP.—Some months ago, on returning from his trip around the world, Mr. W. J. Bryan came out with a strong advocacy of government ownership. He now abandons it, and says: "Government ownership is not an immediate issue. A large majority of the people still hope for effective regulation. While they so hope they will not consider government ownership. While many Democrats believe, and Mr. Bryan is one of them, that public ownership of railroads is the ultimate solution of the problem, still those who believe that the public will finally in self-defense be driven to ownership, recognize that regulation must be tried under the most favorable circumstances before the masses will be ready to try a more radical remedy. Regulation cannot be sufficiently tried within the next year. There is no desire anywhere to make government ownership an issue in 1908. Mr. Bryan fully agrees with those who believe that it would be unwise to turn attention from regulation, on which the people are ready to act, to government ownership, on which the people are not ready to act. To inject the government ownership question into the next campaign would simply give representatives of the railroads a chance to dodge the issues of regulation and deceive the public."

DOCTRINE OF POST-ROADS.—An interesting article on "The Post-roads Power of Congress," by J. Walter Lord, appears in the July 19th number of the *North American Review*. He traces his theme historically and comes to the conclusion that the *post-roads* clause "will apply to every avenue upon which the mails are carried by merely declaring such avenue to be a post-road." Then he goes on to say: "If, therefore, Congress might exercise a control over railroads, might it not exercise a like control over trolley systems, the streets of the cities, the highways of the States, all of which in their primary nature are essentially instruments of State sovereignity? Where would this control stop? It is difficult to perceive. For, under the guise of facilitating the postal service or keeping it up to the highest point of efficiency, there would seem to be no legal barrier to the scope of Congressional action, once the principle is asserted and sustained that Congress might exercise the control which is contemplated. The necessity of any Act which Congress might deem expedient to facilitate the postal service would not be subject to consideration by the Courts, because questions of expediency in legislation belong to the legislative and not to the judicial department of Government. Is, then, the *post-roads* power to supersede the *commerce* power, as it certainly will if the construction proposed becomes effective? Is a power regarded by the founders of our Government as 'in every view a harmless power' and surrendered by the States without question or deliberation, to be substituted for a power regarded by these founders as one vital to the Union and surrendered by some States only after considerable protest? Is a power heretofore rarely exercised, and then, too, always in a guarded manner and with due recognition of the rights of the States, over a century of national existence, to be given a broader scope than one which, during that period, has served to preserve the integrity of the Union, and which, for this purpose, is comprehensive enough to meet all the necessities of the future? The time may be close at hand when these questions will have to be answered."

TUNGSTEN MINERAL.—According to a bulletin of the U. S. Geological Survey, tungsten to the value of $393,667 was produced last year in the United States, for use in the manufacture of steel for high-speed tools. The price has advanced from 30 cents per pound in 1905 to 60 cents per pound in the spring of 1907. Large deposits of tungsten have been found in Australia, and a special investigation has been commenced in this country with a view to locating further deposits here.

POLICE SIGNAL SYSTEM.—Police Commissioner Bingham, of New York City, states that he intends to improve the police telegraph system in Manhattan and the Bronx. The work will begin at once. Prof. George F. Sever, consulting engineer of the department, will aid in rehabilitating the system. The commissioner wants a system through which it will be possible to notify policemen on duty at railroad stations, ferries, and other posts when they are urgently wanted either at their stations or at headquarters. It is proposed to accomplish this by the display of different colored lights by night and by the sounding of a bell by day from various signal boxes. The signals will be sent out direct from the telegraph bureau at headquarters. It is understood that both the police and fire alarm systems are in a serious state of inefficiency.

PAY AS YOU ENTER is a rule that has long applied to the elevated and subway lines in New York City, but has not been recognized as applicable to surface trolley cars. For some two years past, however, "pay-as-you-enter" cars have been in operation on the street car lines of Montreal, Canada, with marked success, and it is now announced that the Madison and Fourth Avenue line has been selected by the management of the New York City Railway Company as the one on which to try the pay-as-you-enter cars now being built for the company. If found to be practicable they will be introduced on other lines. The Fourth and Madison Avenue line has been chosen for this experimental purpose as it is as free from curves and intersecting points as any of the lines in New York. The question of curves has much to do with the installation of the cars. They necessarily have long, extending platforms, capable of accommodating 30 or more passengers, but it is thought that no difficulty will be experienced on the line selected. It is understood that the conductor will be stationed in some kind of a box or railed space at the car entrance; but the details of the car have not been given out yet.

LONDON UTILITIES.—In a discussion of public utilities in London, the *Financial Times* of that city says: "Anyone who compares the position of tramway and gas and electric lighting companies in New York State with the position of similar companies in Great Britain will admit that there is a worse fate than having to submit matters for arbitration and inspection to a tribunal of five trained, independent men. With us the fate of such public utilities is placed in the hands of local authorities, with whom it is almost impossible to negotiate on a proper business basis. The full experience of British capitalists and engineers in negotiating tramway and lighting concessions with local authorities has never been made public, since no good purpose can apparently be served by making an open record of vexatious delays, irritating vacillations, impossible demands, and the other elements in a struggle with ignorance, stupidity and political prejudice. But it is notorious that the local authorities have used their almost absolute power to extort onerous conditions from companies, and to impose upon them obligations which could not be justified by any legitimate argument. No Board of Commission, composed of men of education and position, free from political promises and sentimental fads, could ever bring about such disastrous results, no matter what blunders they might make. No company which has had any dealings with local authorities would hesitate to select such a commission to be its judge and controller in preference to any municipality or county council."

PROFIT SHARING.—The Boston, Mass., Consolidated Gas Company has credited to the most efficient of its employees the sum of $26,029, which amount is 7 per cent of the earnings of each employee for the nine months ending June 30. This profit-sharing scheme establishes a partnership between the company and its employees in a similar manner that the sliding scale provides a like interest between the public and the company. Premiums, in addition to the regular compensation, are provided for the best employees of the company. These premiums are based on the annual salaries of the employees at the same rate as the dividends for the same period are paid on the stock of the company. These premiums, in general, are applied towards the purchase of the preferred stock in the Massachusetts Gas Company, the same to be the absolute property of the employee. By the operation of the so-called sliding scale act, the future divisible profits of the company are made to depend upon the price charged for gas. For every reduction of 5 cents per 1000, the company may pay 1 per cent additional in dividends. As the amount of the premium allowed each employee depends upon the rate of dividends on the stock of the company, and as the rate of these dividends depends upon the price of gas, the employee has a strong added incentive to do his work as economically and efficiently as possible. Every man in the company, as a possible profit sharer, or as an owner of stock in the Massachusetts Gas Company, thus has an owner's interest in promoting the welfare of the business. It is intended by the company ultimately to include as profit sharers all employees who are, in their judgment, temperate, energetic, honest, capable and efficient. But if all such employees are not included in any year, it is the aim of the company to have the list made up of these employees who have displayed the greatest regularity, intelligence and energy in the business of the company.

MOVING SIDEWALKS.—The Public Service Commission of New York City has taken under consideration a project for the construction of a moving platform under Broadway, between Fourteenth and Forty-Second Streets, which it is contended would not only greatly relieve the congestion on this thoroughfare, but would be of special benefit to the shopping and theater-going crowds. This project was explained in a communication from the Continuous Rapid Transit Securities Company, asking for an opportunity to give a demonstration of its moving platform railway. The company claims a capacity equal to three times that of a five-car train service, under a one-minute headway, and six times that of the best surface-car trolley traffic. There was submitted with this letter an engraving of the proposed "moving platform arcade." This shows an endless train, or, as it appears, an endless row of cross-seats for three persons, approached by two intermediate narrow platforms or strips, moving at slower speed. The company's prospectus states the capacity of the proposed installation as follows: "The proposed moving platform railway will afford a seating capacity exceeding 47,000 passengers an hour in each direction. This is three times the seating capacity of a train system operating five-car local trains upon one-minute headway. It is approximately six times the seating capacity of a system of surface tram-cars operated upon 150-ft. headway. In respect to safety, as compared with train and tram-car operation, particularly in places where traffic is congested, a moment's consideration will show that, even should an individual fall in boarding or leaving the platform, the risk of serious injury is slight, and the aggregate of damage sustained incomparably less than by the existing systems." It is also stated that heat radiated from motors, power brakes and rheostats, being the principal cause of the high temperature in the present subway, the moving platform arcade would be comparatively cool. The total energy required to propel the train of platforms in the proposed arcade during a period of 24 hours will only be about eight per cent of the amount of energy required to move local trains in the present subway service, it is claimed.

Electrical Equipment of the Hall of Records in Manhattan Borough, New York City.

WITHIN the portals of the new Hall of Records, in Manhattan, are the Department of Taxes and Assessments, the Register's office, the Surrogate's court and the Corporation Counsel's office. The structure itself occupies the block north of City Hall Park bounded by Chambers Street, Elm Street, Reade Street and Ottendorfer Square. It is magnificent in conception and palatial in development, and on it were expended over eight years of labor and over $5,000,000 in money. The exterior of the structure is of granite. Above the entrance on Chambers Street is a group of emblematic statuary, and along the cornice are heroic statues of former governors and mayors who have left their impress in the development of the state and city.

The interior finish is in keeping with the exterior in artistic treatment. The main entrance, on Chambers Street, is wainscoted entirely with sienna marble and capped with a beautiful mosaic ceiling. The foyer, designed after that in the Opera House in Paris, is finished also in sienna marble. Broad stairways of sienna marble wind from the entrance to handsome open colonnades on the second floor; while overhead is an elliptical-shaped bronze and glass ceiling. The artistic tendencies of the architects, however, find their best expression in the two court rooms on the fifth floor occupied by the Surrogates. The room on the Reade Street side is finished in English oak with high and elaborately carved wainscoting. The south court room, or the one facing on Chambers Street, is finished in mahogany. Each of the court rooms is provided with a handsome balcony from which visitors may view the proceedings.

While the Hall of Records is noted for its artistic features, it also possesses abundant facilities of a purely utilitarian nature, for in it are stored the countless and invaluable records which bear upon every foot of land on Manhattan Island and upon estates in which hundreds of thousands of persons are interested. All the vaults and cases are of fireproof construction and the desks and interior finish have been treated to render them likewise proof against flame.

POWER PLANT.

The steam and electrical equipment occupies the entire basement floor, and the lay-out is such that each division is provided with a separate room. In the boiler room are three 300-hp water-tube boilers, and two 350-hp water-tube boilers. The fronts are finished with enameled brick and the furnaces are fitted with shaking grates. Pop safety valves are also provided and non-lifting injectors connected so that any boiler can be fed by any injector. The coal bunkers are located under the Reade Street sidewalk, where provision for 500 tons is made. An industrial railway system carries the coal to the boiler room and the ashes are removed to the sidewalk by the aid of a hydraulic elevator.

Each boiler feeds steam into a 12-in. main through 8-in. steam connections. The main runs through the boiler room and passes out at each end into and through a corridor separating the boiler and engine rooms. Pump rooms are located at each end of the boiler room. In the pump room on the Ottendorfer Square side there are three duplex pumps for boiler feeding purposes connected to take water from the city water mains or from the steam heat drip lines. A tank located in a pit in this room receives the clean water from traps on the drip lines on the power main and its branches, from which the water is returned to the boiler by a duplex pump. The unclean water is collected in another tank and is pumped thence into the city sewer. Blow-off pipes connect to a third tank. The pumps with one exception are all controlled by governors, and the pumps in the pit are cross-connected so that either pump may be used on either tank. All the exhaust steam mains and the various drip lines of the entire plant are carried in trenches in the floor covered with cast-iron cover plates. The main exhaust line is run to a muffler tank, and thence to a feed-water heater. After passing through the feed-water heater the steam

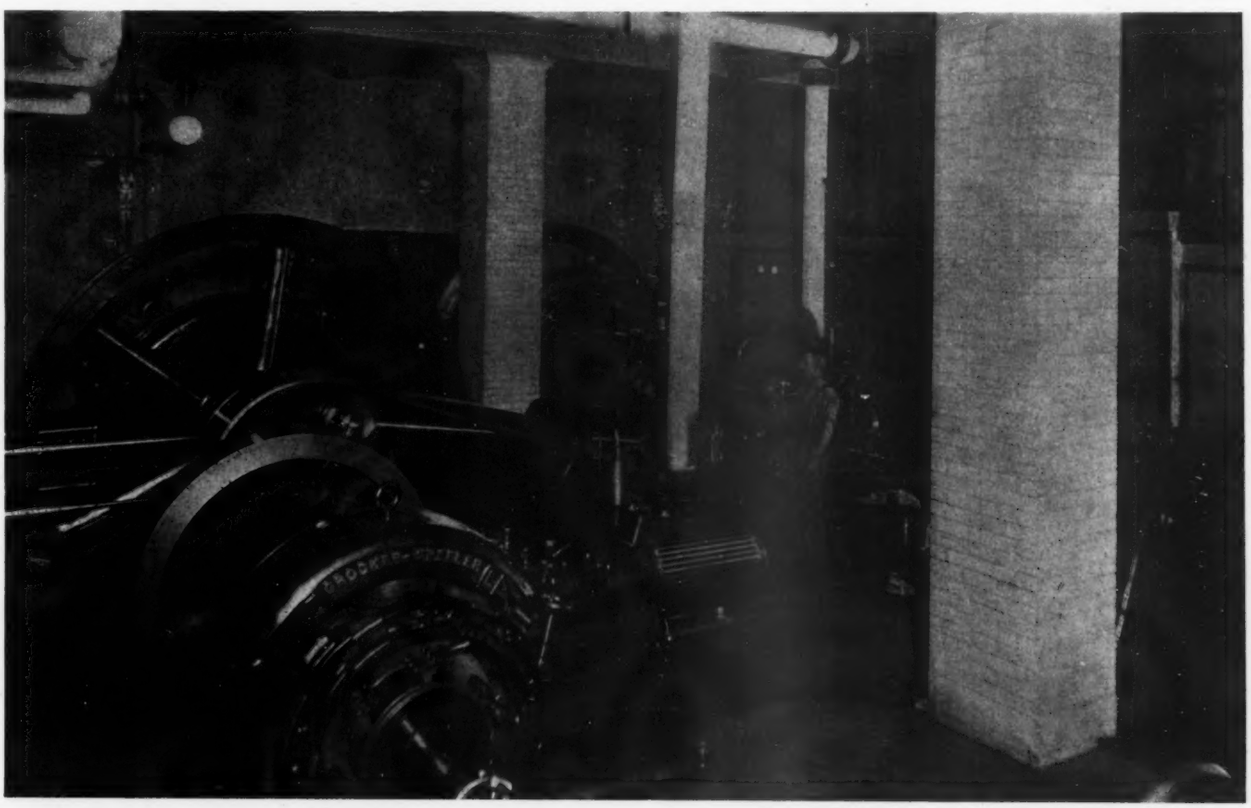


FIG. I.—POWER PLANT, HALL OF RECORDS, NEW YORK CITY.

is used for heating or discharged through an exhaust pipe line to the atmosphere, depending on the season of the year. The feed-water after passing through the heater and before being pumped into the boilers passes through a feed-water filter.

In the pump room on the opposite side of the boiler room are filters for the drinking water used in the building; steam and electrically-driven pumps for supplying water to tanks on the top floor; hot water tanks, etc. A distilled water plant for supplying drinking water to the cooling tank of an absorption ice machine is also installed in this room.

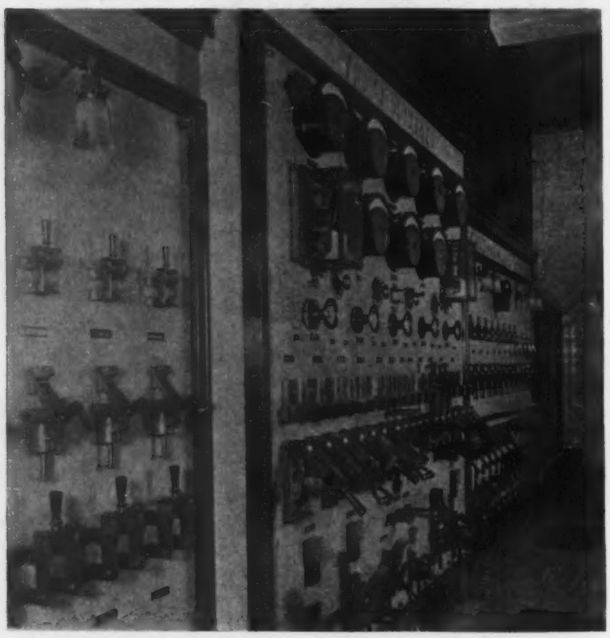


FIG. 2.—SWITCHBOARD, HALL OF RECORDS.

A very thorough system of ventilation is installed. This is electrically driven and is in brief as follows: At each end of the basement is a cold air chamber with an air filtering surface of large mesh wire screens covered with cheese cloth. The screens are held in place by buttons and can be removed very easily for renewal and repairs. Located in the west end are two 20-hp motors wound to run at 90, 110 and 130 r. p. m. and coupled to two 9-ft. blowers; also one 40-hp motor, wound to run at 120, 150 and 180 r. p. m., and coupled to a 7-ft. blower and one 8-ft. exhaust fan on the same shaft. In the east end are two 20-hp motors, the same as in the west end, and one 25-hp motor wound to run at 180, 225 and 270 r. p. m. and coupled to a 5-ft. blower and a 5½-ft. exhaust fan on the same shaft. The four 20-hp motor-driven fans supply the fresh air to all the floors except the basement, which is supplied by the 40-hp motor-driven set in the west end and the 25-hp motor-driven set in the east end. On the top floor are four exhaust fans 6 ft. in diameter used for removing the foul air from all the rooms above the basement floor. These fans are driven by 5-hp motors running at 250 r. p. m. The motors and blowers are set on bases of white-enameled brick capped with bluestone.

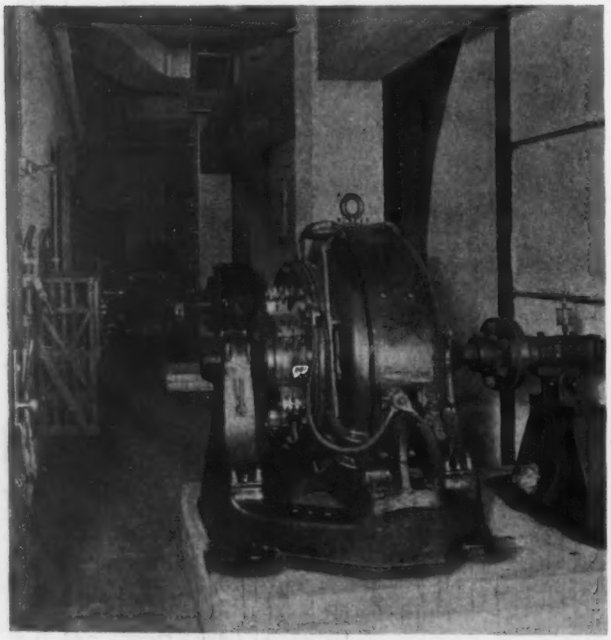


FIG. 3.—MOTOR-DRIVEN VENTILATING APPARATUS.

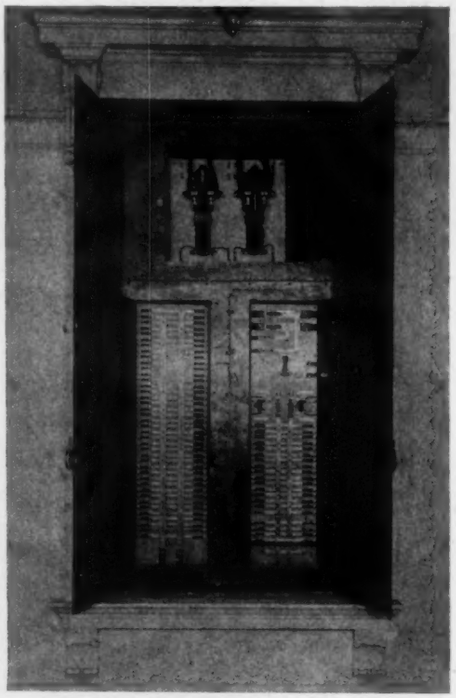


FIG. 4.—PANEL BOARD SHOWING SOLENOID SWITCHES.

The engine room is located in the center of the basement and has walls of white tile and a terrazza floor. Air ducts over the switchboard and at each end of the room provide ventilation. The room is lighted by four enclosed arc lamps and by incandescent lamps on wall brackets. The generating

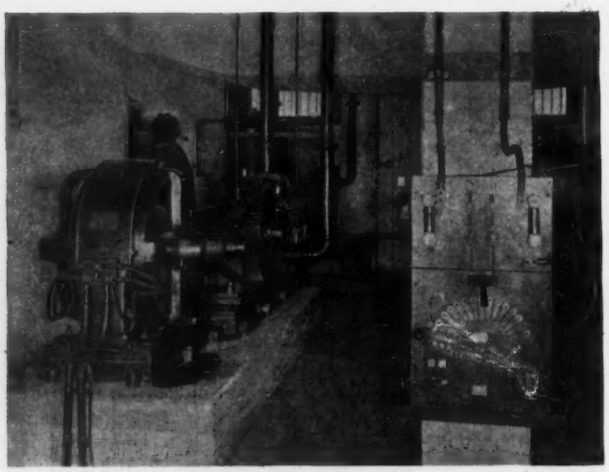


FIG. 5.—MOTOR-DRIVEN VACUUM CLEANING APPARATUS.

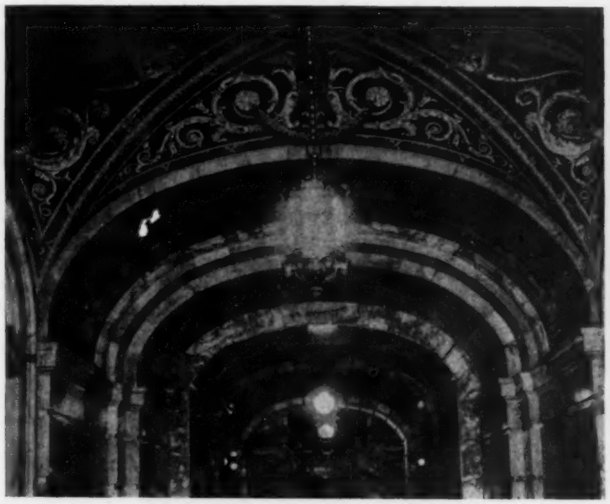


FIG. 6.—OTTENDORFER SQUARE VESTIBULE.

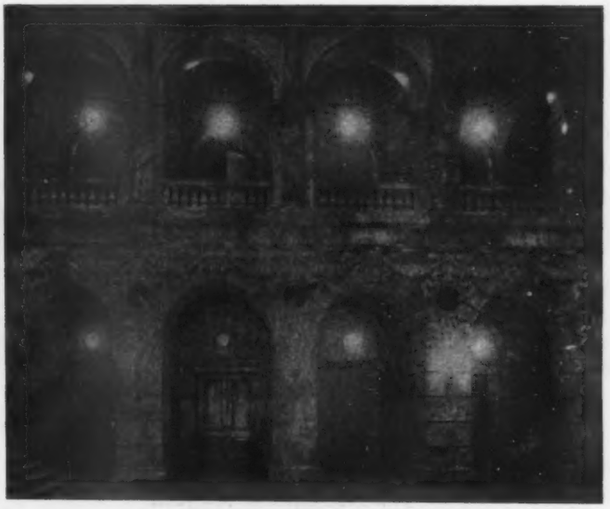


FIG. 9.—FOYER FROM MAIN ENTRANCE.

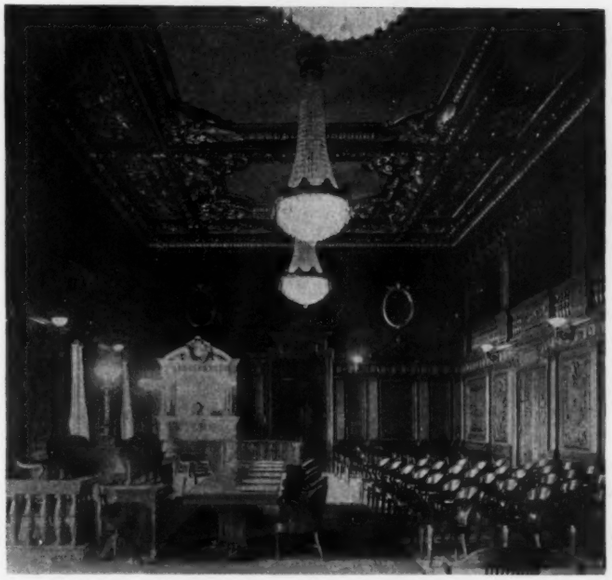


FIG. 7.—SOUTH SURROGATE'S COURT ROOM.

FIG. 10.—NORTH SURROGATE'S COURT ROOM.

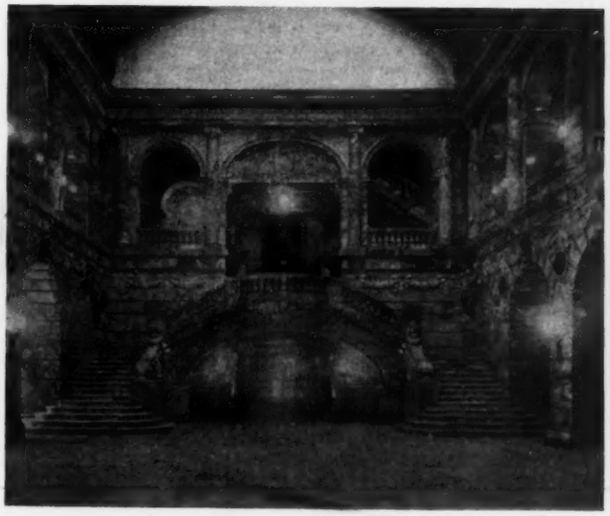


FIG. 8.—STAIRWAY IN FOYER.

FIG. 11.—GENERAL VIEW OF LAW LIBRARY.

SPECIAL LIGHTING FEATURES, HALL OF RECORDS, MANHATTAN, NEW YORK CITY.

equipment consists of two 150-kw generators direct-connected to horizontal Corliss engines, one 100-kw generator, direct-connected to a Corliss engine and a 50-kw generator, driven direct by a high-speed engine. The generators are compound-wound and deliver direct-current at a potential of 120 volts. Connection from the steam main in the corridor is made to each engine. On an enamelled brick base at one end of the engine room is a small booster set for supplying a battery installed in a room back of the engine room and separated from it by a corridor. The battery has a capacity of 1000 ampere-hours.

The switchboard which is placed on the Chambers Street side of the engine room is 33 ft. long and 10 ft. high. It is made of Tennessee marble bordered with Belgian black marble. In the center of the board are the machine panels fitted with the usual arrangement of switches, rheostats, equalizers, circuit-breakers, meters, etc. The panels to the west are for motor and hall lighting circuits; a separate circuit controlled from the switchboard being provided for the hall-lamps for watchmen at night. The panels to the east are used for controlling the general lighting circuits throughout the building. Each circuit is provided with a knife switch and circuit breaker.

There are about 100 clocks throughout the building, all of which are electrically controlled from a master clock in the basement. A telephone switchboard having 125 connections is also located in the basement. The vacuum cleaning system is employed in the building and in a room on the Chambers Street side is a vacuum pump driven by a 35-hp motor.

DISTRIBUTION OF CIRCUITS.

The building contains eight floors besides a mezzanine floor between the fifth and sixth stories, a cellar, basement and attic. Outlets for circuit wiring are provided as follows: 16 outlets for as many enclosed arc lamps; 1792 outlets for 4557 incandescent lamps; 289 outlets for as many insertion plugs; 208 outlets for 208 local switches not including 140 outlets for cut-outs; 6 outlets for 6 elevator cable junctions; 8 outlets for 8 out-door outlet junctions, making the total number of outlets requiring outlet boxes 2319. The outlets are connected to distributing or branch circuits fed from feeders or mains through cutouts grouped at various centers of distribution. The circuits and feeders are two-wire throughout and all wires are enclosed in rigid conduit.

The feeder system includes distinct feeders for office and other general lighting, for hall lamps, and for motor circuits respectively. The feeders run to certain floors only and are prolonged by mains to floors immediately above and below. For lighting purposes the floors may be considered as being sub-divided into various sets of floors, each set having its own feeder system, which is symmetrical with, though independent of, the others. Each floor is divided into four sections, each corresponding to an electrical center of distribution serving as feeder points for the branch circuits in the section. Feeder

FIG. 12.—DETAILS OF CRYSTAL CHANDELIER IN SURROGATE'S COURT ROOM.

FIG. 13.—BRACKET.

FIG. 14.—DETAILS OF CORRIDOR FIXTURE.

lines connect with the first, third, fifth and seventh floors. The feeders on the first floor supply the first floor only. The feeders on the third floor supply the second and fourth floors also. The feeders on the fifth floor supply the sixth also and the feeders on the seventh floor supply the eighth floor in addition. From the eighth floor two mains are extended to the attic.

The hall lamps are supplied from separate feeders located in the basement, third and fifth floors respectively. The feeders

FIG. 15.—VESTIBULE LANTERN.

in the basement supply all the hall lamps up to the second story. The feeders on the third floor also supply the lamps in the second and fourth stories in addition to the lamps over the skylight. The feeders on the fifth floor supply the hall lamps on the fifth, sixth, seventh and eighth floors.

There are forty-two feeders and sixty-two mains apportioned as follows: 31 feeders for lamps; 11 feeders for motors; 51 mains for lamps; 6 mains for motors, and 4 switch mains, There are forty-three distributing centers variously located and the aggregate number of cut-out groups at these centers is 88. There are 800 branch circuits in the building.

The standard voltage of the installation is 116 at the lamps. This allows for a total loss of four volts in the circuit work, one volt of which is allowed in the branch circuits. Each conductor in the feeders and mains is encased in a separate conduit, while each pair of conductors in the branch circuits is provided with a single conduit. The conduits for the greater part run in lines parallel with the walls of the building or rooms.

Special arrangements are made for lighting desks and book cases as follows: Roll-top and flat desks are used and as a rule the floor outlet boxes for the roll-top desks are placed at the center and near the back of the desk. Rigid conduit rises from the floor outlet to a distance of about one foot above the floor and the extension to the fixture is made by flexible steel conduit, a special cable being provided for connection between the two kinds of conduit. In the case of flat-top desks, which usually have two or more fixtures, the circuit is enclosed in rigid conduit which rises from the floor to a distance of three or four feet, and from this point the connection to the fixture is made with flexible steel conduit. Special wiring is provided for all metal furniture, so that the lamps on the cases may be controlled from opposite ends by means of three-point switches. Rigid conduit rises from the floor to these switches and the conduit extends thence to the top of the case, connecting with the various outlet boxes and push-button switch at the opposite end. Where the cases are set against the wall the circuits are run in a somewhat different manner. In these instances the circuit is extended from a wall outlet in rigid conduit to the top of the case, thence to the switch, from which it rises again to the top of the case connecting with an outlet box and finally with the switch at the opposite end.

The space above the skylight over the foyer is lighted by forty lengths of reflectors with a total of 360 32-cp lamps and the circuits for these lamps originate at cutouts located near the elevators on the third floor. There are 60 circuits in all, each circuit containing six lamps. The reflectors are wired so that the lamps may be controlled in groups. These lamps are switched into circuit by 100-ampere solenoid switches, themselves controlled by push buttons on the floor of the foyer.

In the book-binding department on the third floor there are four special circuits provided for electric heating apparatus. The apparatus consists of glue pots and heaters for tools used for leather-burning and book-binding purposes.

Besides the conduit system for electric light wiring, there is an elaborate system of conduit installed for electric signalling, call bell and telephone circuits. An interconnecting cable consisting of 300 wires is run from the main interconnection box in the cellar to the telephone room in the basement. Extension cables are run, in rigid conduit, from the main interconnection boxes to the service boxes located in rooms on the various floors. In each service box is an interconnection strip with a capacity for ten conductors and at each service point where electric signal or service appliances are installed,

FIG. 16.—CORRIDOR ON FIRST FLOOR.

an iron outlet box is provided similar to that used for electric light wiring. This conduit system is used for telephone wires, thermostat wires, call-bell wires and electric clock wires.

FEATURES OF ILLUMINATION.

The corridors throughout the building are lighted from three-lamp fixtures; the lamps being enclosed in an opalescent globe as shown in Fig. 14. The fixtures are suspended from the center of the groined arches in the vaulted ceilings on the lower floors and from the center of the plain dome and the arched

ceilings on the upper floors. In the vestibules on the first floor special fixtures are provided. The lanterns in the vestibule (Fig. 15) are hexagonal in form and approximately two feet between parallel sides. The distance from the top to the bottom of the fixture pendant is about six feet. The body of the fixture has moulded and ornamented corner pilasters with voluted base and leaf work, and caps also voluted and surmounted with richly embellished cartouche. The hood or crown of the lantern is somewhat conical in form and has six dolphins, the head of each centering over the pilasters and the tails entwining and forming a decorative leaf attachment for a ball apex to which the supporting chain is attached. The base pendant has masks centered below the body pilasters and between these grotesques are decorative cartouches each converging in the manner of an inverted cone towards a pendant ornament consisting of leaf work and fruit clusters in high relief. In the Chambers Street vestibule there are three of these chandeliers. There are also installed in this vestibule twelve brackets with three lamps each. The backs of the brackets

FIG. 17.—DETAILS OF CHANDELIER.

are 10 ins. wide and 25 ins. long, making a massive rectangular cartouche, the field of which is moulded and embellished with acanthus leaves in relief. The bracket springs from the lower part of the cartouche somewhat in the form of a voluted cluster of acanthus leaves changing to form into a shorter arm and encircling band to hold the vertical arm of the fixture. The arm is in the form of a torch with trumpet head to hold the bronze shade holder and in addition four Roman facies in relief project from the arm with battle-axe head and spear ends to form a decorative termination. Smaller lanterns are provided in the Ottendorfer Square vestibule (Fig. 6) and in the Elm Street vestibule. In addition each of the latter vestibules is provided with two six-lamp fixtures.

The foyer (Fig. 9), as stated previously, is lighted by lamps behind the domed-glass roof overhead. In addition there are eight three-lamp brackets and four bronze standards under the stairway as shown in Fig. 8. In the corridor to the rear of the foyer are 22 three-lamp fixtures of a design as shown in Fig. 16.

Each of the court rooms on the fifth floor is lighted by three massive crystal chandeliers arranged for 24 16-cp lamps. The fixtures are well shown in the views of the court rooms and in detail in Fig. 12. The chandeliers are a combination of cast bronze and hand-cut glass pendants. The cast rim of the fixture is a massive band, 6 ins. wide and 4½ ft. in diameter with a large bead, reeded and ribboned and with 4-in. rosettes in relief. From the rosettes 12-in. pendant bronze drops are attached to the fixture and each motif of the pendant consists of a large cut-glass sphere, approximately 3-ins. in diameter, standing clear of the fixture. Below the bronze band there are seven tiers of flat, cut-glass pendants hung in circles of diminishing diameter and finished at the center with a 6-in. cut-glass sphere. These tiers form an inverted cone giving the effect of a solid crystal. Each prism is hung closely so as to conceal the metal supports. The bronze rim is supported by cast bronze arms in the form of double reversed consols and the projecting volutes of engaging consols support pendants of cut glass.

On each judge's desk there are provided two cast bronze standards of pleasing design. These are about four feet high and have opalescent glass globes in which three lamps are enclosed. The brackets about the room each contain two lamps. The bracket is shown in detail in Fig. 13. It will be noted that these are fixed at different heights in each court room to conform to the decorative scheme. In the galleries back of the court rooms small crystal fixtures somewhat similar in design to the larger ones in the court room provide for the illumination. There are four of these fixtures in each gallery and each fixture holds three lamps.

Fig. 11 shows the method used for lighting the law library on the sixth floor. As stated elsewhere, the lamps around the metal cases may be controlled from either end of the case by means of three-point snap switches. There are 75 lamps provided for the cases. The design of a fixture somewhat similar to those in the law library, the only difference being in the number of brackets, is shown in detail in Fig. 17. Each fixture holds 12 lamps. There are six two-lamp standards provided for the desks. These standards are 16 ins. high. The base is in the form of a tripod, 8 ins. extreme diameter, with crouched legs and claws and an ornate cartouche on three sides. The shaft is 1½ ins. in diameter at the base and one inch at the top, which is carried through the shade and terminates in a hood and acorn top. The shaft is reeded and holds a cast bronze shade frame divided into six divisions for holding opalescent glass. These lamps are fed from outlet boxes in the floor.

Heating Effect of Quadrature Currents in Rotary Converters.

By J. H. Hunt.

Under the condition of constant armature heating, currents in time quadrature to the impressed e. m. f. reduce the rating of rotary converters to a greater extent than the same percentage of out-of-phase currents do in synchronous motors or alternating-current generators. As proof of this statement consider a two-pole n-ring converter and let

E_o = volts at the commutator

I_o = amperes of direct current

E_n = volts between adjacent slip-rings

I_n = alternating amperes in the armature winding between adjacent slip-rings.

Then

$$E_o I_o = n E_n I_n \qquad (1)$$

assuming initially that there are no losses and that the alternating current is exactly opposite in time phase to the alternating e. m. f.

$$E_n = \frac{E_o}{2} \sin \frac{\pi}{n} = 2 \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}} \frac{\pi}{n} E_o \sin \frac{\pi}{n} \qquad (2)$$

and

$$E_0 I_0 = n I_n \frac{E_0}{\sqrt{2}} \sin \frac{\pi}{n}$$

$$I_n = \frac{\sqrt{2}\, I_0}{\pi \over n \sin \frac{\pi}{n}} \qquad (3)$$

Let r and r' (Fig. 1) be the points of attachment of adjacent collector rings, and let the line $O\ M$ bisect the arc $r\ r'$. Consider any armature conductor C between r and r'. Let wt be the angle between $O\ M$ and the axis of the field $x\ x'$. The alternating current between the collector rings is at its maximum value $\sqrt{2}\, I_n = \frac{2 I_0}{\pi / n \sin \frac{\pi}{n}}$ when $wt = 0°$, and its value at any instant $= \frac{2 I_0}{\pi / n \sin \frac{\pi}{n}} \cos wt$. The direct current, $\frac{I_0}{2}$, in C is reversed each time it passes a brush. Then, in any conductor C situated at an angle α from $O\ M$, the actual current.

$$i = \frac{2 I_0}{\pi / n \sin \frac{\pi}{n}} \cos wt \pm \frac{I_0}{2} \qquad (4)$$

in which the double sign is to be taken as plus from $wt = 90° - \alpha$ to $wt = 270° - \alpha$, and as minus from $wt = 270° - \alpha$ to $wt = 450° - \alpha$, or from $wt = -(90° + \alpha)$ to $wt = 90° - \alpha$ these being the times when the conductor C passes under a

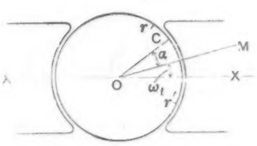


FIG. 1.—SIMPLE ROTARY, TWO-POLE MODEL.

brush. Although α is a space angle, it determines also the time phase of the alternating current at the instant that the direct current is reversed.

Equation (4), taken between the limits $wt = -(90° + \alpha)$ to $wt = (90° - \alpha)$, gives the instantaneous value of the actual current in the conductor during the time this conductor is moving from one brush to another. Then the average rate at which heat is generated in this conductor is proportional to

$$\frac{1}{\pi} \int_{-(90° + \alpha)}^{(90° - \alpha)} i^2\, d\ (wt)$$

$$= \frac{1}{\pi} \int_{-(90° + \alpha)}^{(90° - \alpha)} \frac{I_0^2}{4} \left(\frac{4 \cos wt}{\pi / n \sin \frac{\pi}{n}} - 1 \right)^2 d\ (wt)$$

$$= \frac{I_0^2}{4} \left(1 - \frac{16 \cos \alpha}{\pi \, n \sin \frac{\pi}{n}} + \frac{8}{\pi^2 \sin^2 \frac{\pi}{n}} \right) \qquad (6)$$

Since the rate at which heat would be generated in the chosen conductor C by the direct current alone is proportional to $\frac{I_0^2}{4}$, equation (6) shows that the same conductor C, when the armature is running as a rotary converter has

$$\left(1 - \frac{16 \cos \alpha}{\pi \, n \sin \frac{\pi}{n}} + \frac{8}{\pi^2 \sin^2 \frac{\pi}{n}} \right)$$

times as much heat produced in it as when run as a direct-current generator with the same output. As is evident from the above factor, less heat is generated in the conductor situated on $O\ M$ than in any other, and the heating increases as the angle α increases. As α is determined by the number of rings, the greater the number of rings the smaller the difference in the heating in different conductors.

Assuming perfect conduction of heat within the armature, the rating is determined, so far as heating is concerned, by the average heating of all the conductors between adjacent slip-rings. The average heating between adjacent slip-rings is proportional to

$$\frac{1}{\frac{\pi}{2 - \frac{\pi}{n}}} \int_{-\frac{\pi}{n}}^{\frac{\pi}{n}} \frac{I_0^2}{4} \left(1 - \frac{16 \cos \alpha}{\pi \, n \sin \frac{\pi}{n}} + \frac{8}{\pi^2 \sin^2 \frac{\pi}{n}} \right) d\ (\alpha)$$

$$= \frac{I_0^2}{4} \left(1 - \frac{16}{\pi^2} + \frac{8}{\pi^2 \sin^2 \frac{\pi}{n}} \right) \qquad (7)$$

Thus the average heating in the armature of an n-ring converter is $1 - \frac{16}{\pi^2} + \frac{8}{\pi^2 \sin^2 \frac{\pi}{n}}$ times as much as though the armature were giving the same output as a direct-current generator; and for the same heating, the rating may be

$$\frac{1}{\sqrt{1 - \frac{16}{\pi^2} + \frac{8}{\pi^2 \sin^2 \frac{\pi}{n}}}}$$

times as much.

The demonstration above, which may be found in many text books on alternating current machinery, is limited in its application, because it is based on the assumption that the alternating current is exactly opposite in time phase to the alternating e. m. f., and is, therefore, either exactly in time phase with, or opposite in time-phase to, the direct current.

Assuming now the same value of direct current and put $E_0\ I_0$ as before, and also assuming that the alternating current is a time angle of $180° \pm \Theta$ away from the alternating e. m. f., it is evident that this current may be divided into two components, one opposite in time phase to the e. m. f., and one in time quadrature with the e. m. f. The maximum value of the power component is $\frac{2 I_0}{\pi / n \sin \frac{\pi}{n}}$ or the same as the maximum value of the alternating current at 100 per cent power factor and the instantaneous value of this component is $\frac{2 I_0}{\pi / n \sin \frac{\pi}{n}} \cos wt$. The

maximum value of the quadrature component is $\frac{2I_0}{\pi} \tan\Theta$

$$n \sin \frac{\pi}{n}$$

and its instantaneous value is $\frac{2I_0}{\pi} \tan\Theta \sin wt.$

$$n \sin \frac{\pi}{n}$$

$$i = \sqrt{\left(\frac{2I_0}{n \sin \frac{\pi}{n}} \cos wt \pm \frac{I_0}{2}\right)^2 + \left(\frac{2I_0 \tan\Theta \sin wt}{n \sin \frac{\pi}{n}}\right)^2}$$

$$= \frac{I_0}{2} \sqrt{1 \pm \frac{8 \cos wt}{n \sin \frac{\pi}{n}} + \frac{16 \cos^2 wt}{n^2 \sin^2 \frac{\pi}{n}} + \frac{16 \tan^2\Theta \sin^2 wt}{n^2 \sin^2 \frac{\pi}{n}}} \qquad (8)$$

in which the plus and minus signs are to be selected by the

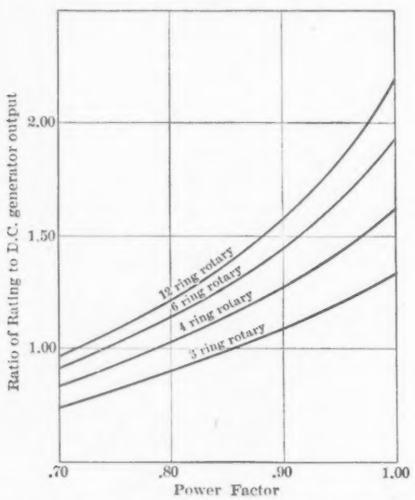


FIG. 2.—COMPARATIVE RATING AND POWER FACTOR FOR CONSTANT HEATING.

method used with equation (4). The average heating in any conductor is proportional to

$$\frac{1}{\pi} \frac{I^2}{4} \int_{-(90^\circ + \alpha)}^{(90^\circ - \alpha)} \left(1 - \frac{8 \cos wt}{n \sin \frac{\pi}{n}} + \frac{16 \cos^2 wt}{n^2 \sin^2 \frac{\pi}{n}} + \frac{16 \tan^2\Theta \sin^2 wt}{n^2 \sin^2 \frac{\pi}{n}}\right) d(wt)$$

$$= \frac{I_0^2}{4} \left(1 - \frac{16 \cos\alpha}{\pi n \sin \frac{\pi}{n}} + \frac{8 \sec^2\Theta}{n^2 \sin^2 \frac{\pi}{n}}\right) \qquad (9)$$

The average heating for the entire armature is proportional to

$$\frac{1}{2\pi/n} \frac{I_0^2}{4} \int_{-\frac{\pi}{n}}^{\frac{\pi}{n}} \left(1 - \frac{16 \cos\alpha}{\pi n \sin \frac{\pi}{n}} + \frac{8 \sec^2\Theta}{n^2 \sin^2 \frac{\pi}{n}}\right) d\alpha$$

$$= \frac{I_0^2}{4} \left(1 - \frac{16}{\pi^2} + \frac{8 \sec^2\Theta}{n^2 \sin^2 \frac{\pi}{n}}\right) \qquad (10)$$

Therefore the heating in an n-ring rotary taking alternating current $180^\circ \pm \Theta$ time degrees away from the e. m. f. is

$$\left(1 - \frac{16}{\pi^2} + \frac{8 \sec^2\Theta}{n^2 \sin^2 \frac{\pi}{n}}\right)$$

times as much as for the same armature giving the same output as a direct-current generator, and on the basis of heating may be rated

$$\frac{1}{\sqrt{\left(1 - \frac{16}{\pi^2} + \frac{8 \sec^2\Theta}{n^2 \sin^2 \frac{\pi}{n}}\right)}}$$

times as much as the direct-current generator.

When $\sqrt{\left(1 - \frac{16}{\pi^2} + \frac{8 \sec^2\Theta}{n^2 \sin^2 \frac{\pi}{n}}\right)} = 1$ (11)

or when $\left(1 - \frac{16}{\pi^2} + \frac{8 \sec^2\Theta}{n^2 \sin^2 \frac{\pi}{n}}\right) = 1$

the rating will be the same, so far as heating is concerned, as

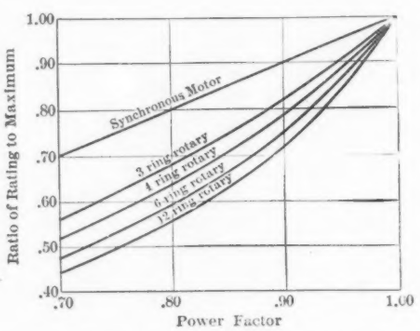


FIG. 3.—PERCENTAGE RATING AND POWER FACTOR FOR CONSTANT HEATING.

the direct-current generator. The following table has been obtained from equation (11):

Number of rings on the rotary converter.	Power factor at which the rating equals that of a direct-current generator.
3	.854
4	.784
6	.741
12	.715

Fig. 2 shows how the ratings of rotary converters having various number of rings increase to the maximum as the power factor increases, the ratings being taken in their ratio to the ratings of the same machines used as direct-current generators. Fig. 3 shows the same relations, with the various ratings plotted in per cent of their maximum. The curve for a synchronous motor having any number of phases is added in this figure to show the greater heating effect of the same percentage of quadrature current in the rotaries (same power factor), as compared with the synchronous motor. Fig. 4 shows the decrease of the copper losses as the power factor rises, both for rotary converters and synchronous motor, based on the assumption that the total input is constant.

For the purpose of checking the above results, two heat runs were made on a small four-phase (so-called two-phase) four-

pole 60-cycle rotary converter, having a nominal rating of 10 kilowatts at 125 volts on the direct-current end. Power was supplied through four slip-rings on the alternating-current end, and a three-hour run was made under the following conditions:

Input				Speed.	Field.	Output	
Volt.	Amp.	Kw.	P. F.	R. P. M.	Amp.	Volt.	Amp.
89	47.5	3.32	.785	1200	.66	114	48

Rise in temperature in degrees Fahrenheit: Core, 50 degrees; comm., 64 degrees.

The brushes were then shifted forward to give good commutation as a direct-current generator, and a three hours' run made under the following conditions:

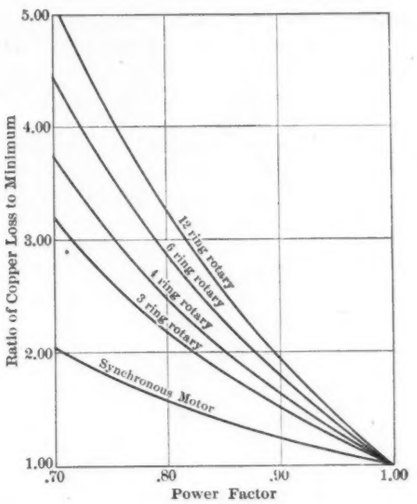


FIG. 4.—COPPER LOSS AND POWER FACTOR FOR CONSTANT INPUT.

Output		Field.	Speed.
Volt.	Arm. Amp.	Amp.	R. P. M.
114	48	1.08	1200

Rise in temperature in degrees Fahrenheit: Core, 49 degrees; comm., 61 degrees. It will be observed that the power factor when run as a rotary converter was adjusted to .785, the value at which the armature copper losses in a four-ring rotary converter equal the armature copper losses in the same machine delivering the same current output as a direct-current generator. The temperature rises were found to be closely the same for the two tests. Since the stray power was supplied by the alternating current during the first test, and by the belt in the second case, we would expect slightly greater heating in the first case than in the second.

Sub-station Equipment and Operation, Chicago Edison Company and Commonwealth Electric Company.

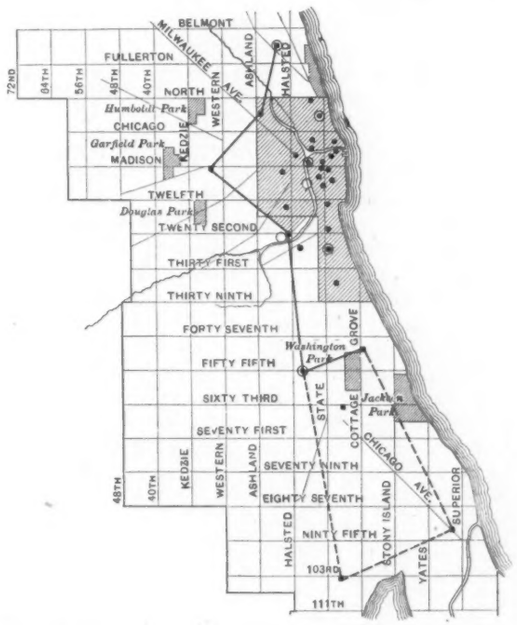
BY R. G. GRANT.

There are two general systems of secondary distribution in Chicago—continuous current is supplied over the Edison three-wire system at 250 volts and 60-cycle lighting and power service by the three-phase, four-wire system at 2200 volts to the centers of distribution, where it is stepped down to 220 and 110 volts. The direct-current district, as seen by the map, extends throughout the business section of the city and the more densely populated portions, while the outlying districts are supplied with 60-cycle current. The former extends from North Avenue on the north to Thirty-ninth Street on the south, and from Ashland Avenue to the lake, and the latter takes care of the portions outside of these boundaries. There is a chain of 60-cycle sub-stations extending around the outside of the direct-current district, as shown by the accompanying sketch. There are also transformer sub-stations at South Chicago and Fernwood, which are supplied with 60-cycle current from the two stations at the southern part of the chain, as indicated by the dotted lines. All of the 60-cycle sub-stations are tied together with tie-lines. The direct current stations are also tied together, since they feed into mains which form a network throughout the direct-current district.

The sub-stations are supplied from two main generating stations in which are installed star-connected turbo-alternators aggregating 60,000-kw capacity. These alternators furnish three-phase, 25-cycle current at 9000 volts over three transmission wires to the sub-stations, and therefore two classes of converting apparatus are necessary, viz., frequency changers for transforming from 25 to 60 cycles, and rotary converters for the direct current output.

The transformation from 9000 volts, 25 cycles to 2200 volts, 60 cycles is effected by means of synchronous motor-generator sets, the machines being Y-connected and the generator having a neutral lead for the three-phase, four-wire system. They are made by the General Electric Company and are 500, 1000 and 2000-kw capacity. The 500 and 1000-kw machines are of the horizontal, two-bearing type, with revolving fields. The small sizes have concentrated windings on the motor, but on the larger sizes the windings are distributed. The motors have a squirrel-cage winding laid in the revolving core, and are started as induction motors at approximately half voltage from an auto-transformer. When synchronous speed is nearly reached, the field circuit is closed, and then, by means of interlocking switches, the machine connections are transferred to the running bus.

There are at present three installations of 2000-kw motor-generators, one in each of three sub-stations. These machines are of the new vertical type with a step and guide bearing for the revolving fields, which is sustained by oil under a pressure of 480 pounds per square inch for the step bearing and 20 pounds for the upper, or guide bearing. The oil pressure is maintained by means of three cylinder pumps driven by motors of 5.5-hp capacity. There are two of these pumps used interchangeably, and the piping system for the oil is provided with check valves, so that in the event of one pump becoming disabled, the other can be started without allowing the oil pressure to go down to a dangerous value. In the generating stations there are gravity systems for holding up the oil pressure a few minutes in case of trouble, but these are not installed in the sub-stations. A compound-wound exciter is carried on the top of the shaft, just above the generator, and the set is started with



MAP SHOWING TWO ELECTRICAL DISTRICTS OF CHICAGO AND CONNECTED 60-CYCLE SUB-STATIONS. DIRECT-CURRENT DISTRICT SHOWN SHADED.

this exciter as a direct-current motor. Owing to the large moment of inertia of the revolving fields of this machine and hence the large amount of current it would take for a considerable time if started in the usual way, it is brought up to nearly synchronous speed by means of the exciter run as a cumulative compound motor from a source of direct current, as other exciters, or from rotary converters if they are installed in the sub-station. About five minutes is consumed in bringing the machine up to speed, and it is then thrown to the half voltage or compensator bus, from which point the operations proceed as in the case of the smaller machines. It is necessary to provide switches to reverse the exciter field, since at starting the armature reaction would be dangerously great if the machine were started as a shunt or differential compound motor. After the motor is running from the high-tension bus, the field circuit is opened and reversed and the exciter is allowed to supply its own field current.

These vertical type machines are the first to be installed, and a comparison of their various features with those of the horizontal type may be of interest.

The principal disadvantages of the horizontal type of frequency-changer are mechanical; the friction loss is considerably greater than in the vertical type where the revolving parts are floated on an oil film, and there is danger of the journals becoming sufficiently worn to allow the pole pieces to strike the armature windings, which danger is eliminated in the vertical type. The low friction losses, combined with a low and well-balanced electrical loss, unite to give an unusually high efficiency. A continuous output of 2667 kw at 75 per cent power-factor is maintained with a temperature rise of 40°F. above the surrounding atmosphere. The efficiency at full load is 91 per cent and at half load, 85 per cent. The regulation from no load to full load is about 6 per cent.

The following figures are given in the comparison of the mechanical features of a 2000-kw vertical type machine, and a 1500-kw machine of the horizontal type:

	Vertical.	Horizontal.
Floor space	101 sq. ft.	188 sq. ft.
Height (with exciter)	14 ft. 6 in.	
Height (without exciter)	11 ft. 6 in.	11 ft. 6 in.
Weight	165,000 pounds	160,000 pounds
Weight of shaft	5,900 "	9,100 "
Weight of mechanical parts	39,000 "	49,000 "

From these figures the advantage of the new type can be readily seen.

The total rated capacity of motor-generators installed in the two companies is about 16,500 kw. In addition to this, two of the stations have auxiliary steam plants which can be used in case of emergency, or at the peak of the load.

The direct current output is furnished by means of rotary converters built by the General Electric Company, and of 500, 1000 and 2000-kw capacity. They are designed to take six-phase, 25-cycle current at 186 volts and deliver direct current at 250 volts to the low-tension bus. At present there are but two 2000-kw rotaries installed. There are also two or three installations of two 100-kw, 125-volt machines in series, the neutral being tapped to the series connection, and several 250-kw, 250-volt rotaries; also two railway machines which are not a part of the Edison system, but supply current for the traction companies and the Illinois Tunnel Company.

The exposition of the equipment of a standard sub-station is best accomplished by tracing the current from the transmission line to the center of distribution, and this method will be followed.

The current flows from the transmission line to the high-tension bus through an oil switch, which is generally a type "C" or type "F"—General Electric—and consists of three pairs of oil cans, each containing one terminal of one phase of the line and of the bus, the two members of each pair being short-circuited by a copper rod when the switch is closed. This short-circuiting mechanism is operated by some kind of an electro-magnetic device controlled from the switchboard by a single pole, double-throw switch. In the case of a type "C," the operating device is a pair of solenoids acting on two plungers, and in the case of a type "F," it is a series motor.

The high-tension bus may supply power to either rotary converters or motor generators. Taking the case of a direct-current station first, the current flows from the high-tension bus through an oil switch for each machine, thence through a transformer, where the voltage is reduced from 9000 to 186, and from three to six phase in the double delta or double star connected secondary. From the transformer secondary it passes through a potential regulator and thence to the six slip-rings of the rotary, through the armature, and from the direct-current brushes to the direct-current bus.

The potential regulator is a transformer in which the primary and secondary are movable with respect to each other through a portion of a revolution. It contains six coils—one for each phase—which are in series and parallel respectively with the leads from the secondary to the rotary. The relative positions of the primary and secondary determine the inductive action of the regulator on the transformer secondary, and hence the pressure at the slip-rings of the rotary, which in turn fixes the direct-current pressure. The movable coil is operated by means of a small induction motor controlled from the switchboard. The neutral point of the transformer is connected through a switch to ground, and is thus at the same potential as the middle point of the three-wire system, which is also grounded. It is therefore possible to operate a rotary on but one side of the system in order to compensate for an unbalanced condition of load. This is generally accomplished, however, by a balancer arranged for the purpose.

Between the oil switch and the transformer are the series transformers—one for each phase—which send current through the solenoids of the overload relays and the current coils of the wattmeters and the power-factor indicators. These transformers are designed for a full load secondary current of 5 amperes. Potential transformers are also shunted across the phases to feed the pressure coils of the wattmeters, the machine voltmeter, the pressure coils of the power-factor indicator and the synchronizer. A potential transformer is also connected across one phase of the high-tension bus to indicate the line pressure and to furnish feed for the fields of the synchronizer. On the direct current side there are—two machine ammeters, + and —, one machine voltmeter, or its equivalent, connected across the outside leads, two standard voltmeters, + and —, which can be connected to any of the direct-current feeders at whose ends the pressure is to be kept constant, or to any of the buses in operation. There are also recording voltmeters connected to pilot wires from the feeder ends—one on each side of the three-wire system.

The machines are protected from damage due to excessive speed or a heavy reverse current by automatic devices designed to open the circuit-breakers under these conditions.

The batteries installed throughout the direct current district are intended for use in emergencies, and not to relieve the generating station at the peak of the load, although this is sometimes done. At each station where batteries are installed, the cells are divided into two equal groups, one on each side of the system, with a neutral leading from the middle point of the battery to the ground. Where a large capacity is desired, a number of these groups are installed. There are generally 75 cells per side, about 5 of which are end cells. The rated capacity in amperes per side for one hour varies from about 1000 to 16,000, the large ones being in the downtown district. The total capacity of the batteries of this system (one hour rate per side) is 60,000 amperes, which would carry the peak load for about 20 minutes at a discharge rate of 120,000 amperes. The largest battery is at the Adams Street station, where three of 5700 amperes per side are installed.

The plates are made by the Electric Storage Battery Company, and range in size from an "H" plate—31 in. x 15½ in. to a "G" plate—15½ in. square. The larger cells have 87 plates—43 positive and 44 negative, and the smaller ones 49—24 positive and 25 negative. The batteries are kept floating on the system ready to take up the load in the event of the 25-cycle supply being interrupted. End cells are cut in or out by means of motor operated end-cell switches controlled from the switchboard, and

floating is accomplished by keeping the pen of a Bristol recording meter (connected across the main battery) on the floating line by the operation of the end cells. Conditions obtaining during charge and discharge are determined by means of the recording voltmeter charts and by observing the specific gravity and voltage of the cells.

Conditions sometimes warrant the use of the batteries to feed back through the rotaries into the high-tension system, and such operations are directed by the load dispatcher. In this case the inverted rotaries are not allowed to operate independently on account of the lack of frequency control, and the danger of running away on an inductive load. Complications of this nature sometimes arise, an instance being a case in which the transmission line failed and the battery discharged back through the rotary, feeding an under-excited synchronous motor on the same high-tension line. The speed-limiting device failed to operate, and the machine was destroyed before the operator could reach the switchboard. The present practice is to run separate lines for rotary converters and motor-generators in order to eliminate this difficulty.

25—60 *cycle transformation.*—This is accomplished by means of synchronous motor-generator sets as described above. The switches connecting the motor to the 25-cycle bus are type "G"—G. I., or type "K_2"—G. E., interlocking, by means of which the motor can be thrown from the compensator bus to the running bus with the field circuit closed. The generator switches are type "A," motor-operated, or type "K." Overload relays are connected to operate each phase independently, so that an overload on one phase will not open the others, as is the case on the motor side. These relays are of the bellows type, capable of adjustment to operate at any predetermined current overload, and after any given number of seconds.

Each generator may be connected to either of two 60-cycle buses through selector switches or interlocking type "K_2" switches. In two of the stations the interlocking feature has been dispensed with in order to operate the two buses together from one machine.

The 60-cycle circuits may also be connected to either of the two buses by the interlocking switches, or by means of hand-operated oil switches made by the Stanley Electric Company, and furnished with a tripping coil actuated by the overload relays, which are of the same form as those on the machines. The different phases of the circuits are operated independently. Regulation of the circuits is accomplished by the use of I. R. S. induction regulators made by the General Electric Company, and operated by three-phase induction motors controlled from the switchboard. The operating current is obtained from transformers on the 60-cycle bus. The feeder-end potential is indicated by voltmeters in connection with line-drop compensators, the settings being determined when the circuit is put into service. Automatic regulation is also used in a few cases, employing potential relays to operate friction clutches, which connect the regulator quadrant to a line of shafting for rotation in the desired direction.

The rated output of each of the regulators in use on the circuits is 75 amperes and 18 kw on the tie-lines, 100 amperes and 24 kw, giving a maximum boost or choke from the neutral position of 240 volts. In the event of a regulator becoming disabled, it can be cut out entirely and the circuit put on bus pressure, or else thrown in parallel with another regulator by means of a transfer board. The bus pressure is maintained constant by using a Tirrill regulator.

A new departure in the operating procedure of these companies was put into effect the first of the year (1907) by means of which two independent 25-cycle buses are maintained at the generating station, the object being, of course, to reduce the possibility of a complete shut-down, due to the failure of a transmission line or a break-down at the generating station. No trouble has as yet been caused by paralleling these two systems in the sub-stations, due to a mistake in executing the orders of the load dispatcher, and the most rigid orders are out covering the operation of lines on the two systems.

Test of a Gas Engine Plant in Boston.

An exhaustive efficiency test of the gas engine electric plant of the J. P. Eustis Manufacturing Company, Boston, was made recently by Messrs. P. R. Nichols and R. F. Knight, of the Massachusetts Institute of Technology. The plant consisted of a 55-hp Bruce-Abbott-Merriam engine direct connected by a flexible coupling to a 30-kw Bullock generator of the 230-240 volt, direct-current type; the auxiliaries consisted of a circulating pump and motor, switchboard for controlling the generator output, starting device and storage battery. The engine was of the vertical, twin-cylinder type with throttling governor, operating on the four-cycle principle. Governing was effected by varying the richness of the explosive mixture. The water circulation was insured by a centrifugal pump driven by a 0.5-hp motor. The water was used over and over, being pumped to a tank on the roof and back. The engine was started by compressed air stored in two steel tanks at a pressure of 240 lbs. per sq. in. These air tanks were filled by an air pump driven by a 1-hp motor. In starting a special set of cams is thrown into service on one cylinder and the air turned on. The engine then begins to turn over, and when the other cylinder has taken up regular explosions, the air is turned off, and the regular set of cams is thrown back into position while the engine comes up to speed.

The gas used by the engine was taken by the company from the city mains at a pressure of about 2 ins. of water, and was measured by a 100-light meter. The engine room is 10 ft. by 20 ft., and the load is light and power for a brass working establishment employing about 60 persons. The power load is on from 7 a. m. to 5:30 p. m., and consists of polishing motors, motor generators for electroplating, etc. The load is of a fluctuating character. A constant load was obtained by a water rheostat when necessary. German silver coils were used for this purpose, each coil having a capacity of 35 amperes. The heating value of the gas was determined by a Junker's calorimeter. The efficiency of the set was found by constant load runs after 6 p. m., the runs averaging one hour in length. All-day runs were also made from 7 a. m. to 6 p. m. In all the runs the voltage was maintained constant at 220 volts. To secure data on the gas used and the energy generated over a longer period of time, the watt-hour meter used was left in circuit 2 weeks, during which time several readings were taken of the watt-hour meter and the gas meter. The gas averaged 590 B. T. U. per cubic foot. The average of all tests after 6 p. m. was 573 B. T. U. per cubic feet. The efficiency results were:

Run, No.	Efficiency of Set.	Efficiency of Engine.	H. P. by Engine.	B. T. U. per H. P. Hour.
1	16.8%	18.75%	27.45	13,150
2	6.47	8.35	8.7	30,400
3	15.9	18.25	16.55	13,960
4 A	21.75	24.66	56.	10,240
4 B	21.7	24.66	55.5	——
5	20.9	23.35	37.2	10,780
7	21.21	23.75	41.7	10,680
8	18.4	20.55	25.8	12,400

In the two weeks' run the total kw hours were 3146 and the total gas used, 92,900 cubic feet. The loss in the circulating pump was 31.9 kw hours, leaving 3114 kw hours as the net energy delivered in the two weeks. The gas consumption per kw hour was 29.8 cu. ft.; the B. T. U. per kw hour output 17,580, and per hp hour of engine assuming an average efficiency of the generator of 89.5 per cent, 11,730 B. T. U. The average thermal efficiency of the engine was 21.7 per cent, and of the set 19.4 per cent. The cost of energy as generated by the set was figured as follows per kw hour from the two-weeks' run assuming a gas cost of $0.70 per thousand cu. ft.:

Cost of gas, 2.09 cents per kw-hour.

Cost of oil, assuming that 1 qt. is consumed per day, the rest being available for use again, .029 cents per kw-hour.

Cost of attendance, 2 hours per day, 0.193 cents per kw-hour.

Total net cost of manufacturing, per kw-hour, 2.312 cents.

On the assumption that the plant represents $3,000 invested, taking 15 per cent interest and depreciation, the fixed charges were 0.555 cents per kw hour. Total energy cost per kw hour, 2.87 cents.

New Telephone Patents.

EXCHANGE IMPROVEMENTS.

With party lines there has been a constant demand for the overcoming of the necessity for a special symbol. With tlfree-wire common-battery systems this demand has been readily met without any essential change in the usual arrangement of circuits and apparatus. For a two wire system of the Dunbar type, J. M. Storkerson, of La Crosse, Wis., has patented an arrangement to give this same result. A separate string of multiple jacks is assigned for each side of the line and these are associated with a single answering jack and signal. Each set of multiple has its own cut-off relay, and these are so interconnected that the line is connected up in opposite direction by the two relays. Thus a call from one jack rings on the opposite limb of the line from a call from the other. Provision is also made to interconnect the busy test so that both sets of jacks will show busy, no matter which carries the plug.

E. B. Heaford, of Omaha, has invented a common-battery system in which the cut-off relay is double wound. One coil is in the line circuit in series. This is the main actuating winding and it is shunted by a non-inductive resistance. The second winding is of high impedance and is connected in series with a condenser across the line. This coil holds up the cut-off relay while ringing current is applied, and thus prevents such current from lighting the line lamp.

A night service attachment for magneto exchanges forms the subject of a patent granted to C. E. Ackerman, of Vernon Township, Mich. This consists of a switch by means of which all the exchange lines may be connected to a bus. Another switch opens the common wire of all the drops. An operator's station is connected from the bus to ground, and one side of certain telephones which are to receive night calls are grounded. Stations allowed to make night calls are given temporary grounding keys. It is suggested that doctors may be given night call code rings. As the night service is grounded, the stations as a whole will not receive the signals.

STATION APPARATUS.

A swinging desk arm has been patented by W. B. Oliver, of Collingswood, N. J., which has some novel features. The arm swings in both vertical and horizontal planes, and carries at its upper end a swinging transmitter, which remains in the vertical position. A receiver hook is arranged to swivel about a horizontal axis, integral with the switch lever. This latter is pivoted at an angle to the vertical so as to come into play as the arm comes down into the horizontal position. The whole apparatus is designed with counterbalancing springs and spring joints so as to "stay put."

As a means of notifying a returning subscriber of a lost call, Mr. W. H. Stinson, of De Funiak Springs, Fla., has invented an indicator. A cup is mounted below a tube, in which small balls may be placed. These latter are retained by a wire passing into the bore of the tube. When the ringer operates it pulls the wire out and allows the balls to fall into the cup.

The breaking of a circuit containing much inductance has always been a source of annoyance due to burning of the contact points. The currents handled in telephony are fortunately most all of so small a magnitude that this difficulty may be tolerated for a considerable period before cleaning of the points is necessary. With the switching currents of automatic systems some counteracting means becomes almost necessary, in the actuating magnet circuits. In order to overcome the difficulty, Mr. C. M. Thompson, of Chicago, has patented an arrangement in which a double wound operating magnet has first one of its windings energized and then the second winding, to neutralize the magnet, when both windings are broken simultaneously, thus avoiding a discharge potential.

AUTOMATIC SYSTEM.

In a patent recently granted to N. E. Norstrom, of Junction City, Kan., an automatic system is described wherein the primary selecting currents are in the form of inpulses sent from a generator at the station of the user. An all-metallic line and polarized relay are used. The index at the subscriber's station is set and the crank turned. The impulses sent out are of a direction to cause the polarized relay to operate the hundreds magnet. When the required number of impulses has been sent the generator is automatically reversed and opposite impulses are sent out to the relay to affect the units selection. The bell is rung by the same movement of the generator. All switching is accomplished automatically, a spring gear transmission for driving the generator assuring a proper speed of rotation for its armature.

Letter to the Editors.

Edison Current.

To the Editors of Electrical World:

Sirs:—The exploitation of the name of Edison receives an amusing illustration in an editorial in your issue of July 20, in the statement "The United States central station Edison voltage is nearly always limited to 250 volts between outers." To the term "Edison current" our eyes have become accustomed through its persistent use for advertising purposes by some of the original direct-current central stations, and I hope that the quotation is not a revelation of a plan of these interests to complement that term with "Edison volts." The use of both terms and even of the addition of "Edison watts," "Edison henries" and similarly the whole line of electrical terms, would be merely amusing were it not for the effect on the electrically uninformed public. The use of "Edison current" for 110-125 volt direct current has led to a widely extended belief among the laity that this term applies to a kind of electricity different from and superior to other kinds, of which the distinction implies the existence. It should be a duty incumbent on all connected with the application of electricity to promote correct ideas relating thereto, and not take part in still more befuddling the ideas of the public in relation to the "subtle fluid." The use of the term "Edison current" is particularly anachronistic at this late period, when practically all of the original Edison companies generate alternating current, and direct-current distribution will soon be a memory of the past.

Chicago, Ill. Jas. T. Chambers.

[The appearance of the word which our correspondent criticizes was due to bad penmanship, combined with poor proof-reading. The qualifying word should have read "direct-current."—Editors.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Reluctance Control.—L. Torda.—An illustrated description of a new variable-speed electric motor or variable-voltage dynamo. The control is based on the variation of the magnetic reluctance of the machine, as shown in Fig. 1, which is a side elevation and an end view of the machine. Air ducts are formed in the magnet cores between the field coils and the yoke. Iron masses in the form of plates are placed in the air ducts, and they are so arranged that they can easily be moved in axial direction inwards or outwards in the air ducts. Two of the plates are supported at one end on rollers, mounted to rotate in slots in the ends of the plates and running freely on the surfaces forming the bottoms of the air ducts. Each plate is fixed at one end to a ring secured by stud bolts to a

traversing frame, which is provided with a screw-threaded central boss for the reception of the adjusting spindle. The spindle is mounted to rotate in the two-arm bracket fixed to the frame of the machine. Hitherto in machines with reluctance control the construction has been so arranged that the insertion of the reluctance, while weakening the main field reduces the field distortion. In the present machine no attempt has been made to influence the field distortion, as the

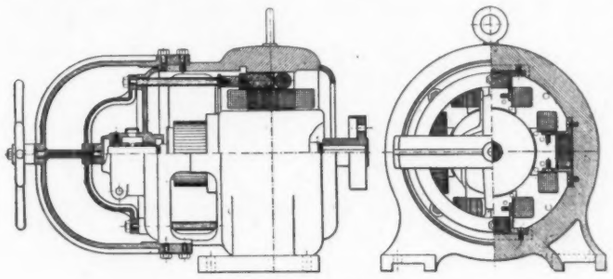


FIG. 1.—VARIABLE-SPEED MOTOR.

air ducts and the adjustable iron masses are placed inside the field magnet system remote from the armature. This has several practical advantages. From a constructional point of view, a simpler and safer arrangement is obtained with movable parts farther away from the rotating armature. Further, the air-gap in the armature in the pole phases may be made as small as mechanically admissible. There is also a reduction of the weight of the adjustable masses by arranging the

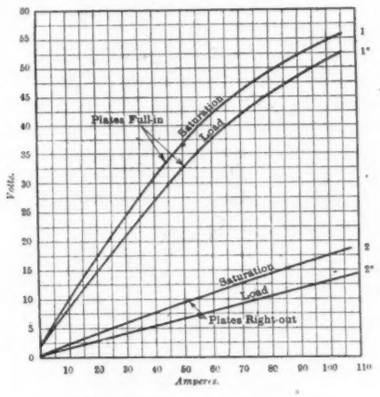


FIG. 2.—RESULTS OF TESTS.

air ducts and the plates in places inside the field magnet system where the magnetic induction is the highest. Fig. 2 gives the results of tests showing the relation between the current and the voltage within the limits of control, one set of curves being for the plates full in and the other for the plates full out. For the maximum current of 100 amperes, the range of voltage is from 13 to 52.—Lond. *Elec.*, July 5.

Lamps and Lighting.

Electric Arc.—UPSON.—An abstract of a (British) Physical Society paper on an experimental investigation of the production of electric arcs between cooled-metal and carbon terminals, in air and hydrogen. Apparatus was exhibited for maintaining the arc in various gases, while one electrode was cooled by means of water circulation. Arcs were described in which the electrodes consisted of carbon, copper, iron and aluminum in different combinations, maintained in air, hydrogen and coal-gas. With a 110-volt supply, metal arcs in hydrogen took the form of a spark discharge. At that voltage the maximum length of arc it was possible to obtain, with current up to 15 amperes, was 0.05 in., except where both electrodes were of the same metal. When carbon is one of the electrodes, a true arc is formed. If carbon is negative the maximum length of arc with the above voltage is 0.07 in. Volt-ampere characteristic curves were shown for arcs in air and hydrogen 0.05 in. in length. The general position of the curve is determined by the material of the negative electrode. With carbon negative, in hydrogen, the curves for various positive electrodes very nearly coincide. With carbon positive, they keep the same curvature, but vary in distance apart, according to the material of the negative. In general the position of the curve is governed by the negative, but its particular shape seems to come from the influence of the surrounding gas. The slope of the curve (ampere horizontal, volts vertical) of the carbon arc in air is much less steep than that of the curve of any arc in hydrogen. The former curve cuts the latter in the neighborhood of 6.5 amperes. The curve for the arc with carbon positive, aluminum negative, in air, is very steep, being equal in this respect to the curves for arcs in hydrogen. Volt-ampere characteristics were shown for copper arcs in air, with (1) positive electrode cooled, (2) negative electrode cooled and (3) neither cooled. Equations for various arcs were obtained giving the voltage in terms of current and arc-length. It was much more difficult to obtain a carbon arc in hydrogen with alternating currents, and no arc could be obtained when the electrodes were copper positive and carbon negative, with 100 volts supply and frequencies of 50 and 80. Similar results were obtained in coal-gas. Apparatus was devised, in accordance with a suggestion by Fleming, to interrupt the arc for a definite period of time. Experiments were tried to determine how long the arc could remain extinguished without losing the power of restarting itself when the e. m. f. was again applied. Curves were shown for arcs with electrodes of solid and cored carbons in air. With cored carbons the time of interruption is greater than with solid, and both are much greater than that for the copper-carbon arc. In hydrogen the copper-carbon arc could not be made to restart itself, if the e. m. f. was removed for more than 0.04 of a second, and for this arc the minimum interruption possibly is far shorter than for any carbon arc in air.—Lond. *Elec.*, July 5; *Phil. Mag.*, July.

Power.

Electric Power on Docks.—W. W. SQUIRE.—A paper read before the Engineering Conference of the (British) Institution of Civil Engineering on electric power for dock equipment, including the relative advantages of electric and hydraulic appliances. The author says that the tendency towards the use of electric appliances is decidedly on the increase and the advantages are such as to indicate still further development with increased experience.—Lond. *Elec. Eng'ing*, June 27.

Water Power Practice.—H. VON SCHON.—The concluding part of his serial on hydroelectric power versus steam for industrial plants. The author describes how to carry on systematically the engineering study of a water power project.—*Eng'ing Mag.*, July.

Electric Power in Steel Works.—J. B. VAN BRUSSEL.—A fully illustrated description of the use of gas and electric power in steel works in Continental Europe.—*Eng'ing Mag.*, July.

Gas Producers.—R. E. MATHOT.—An illustrated article summing up the general principles in the construction of modern gas producers.—*Eng'ing Mag.*, July.

Efficiency in Fuel Burning Under Steam Boilers.—W. D. ENNIS.—The second article in his serial. In the present installment the author deals with the measurement, regulation and control of furnace draft.—*Eng'ing Magazine*, July.

Traction.

Electric Traction on Railways.—P. DAWSON.—A second article on this subject in which he gives some financial considerations in connection with electric railways. The gist of the paper is summed up as follows: After referring to the character of an electric railway load on the generating station, the author discusses two main causes which conduce to electrification of existing railways, viz., (1) reduction in working expenses and (2) the desire for the better utilization of existing facilities. A steam locomotive in suburban work consumes fuel for about 76 per cent of its life, but does useful work only during about 28 per cent. Detailed figures are given for

the running costs of steam locomotives. Another basis of comparison is by weight and carrying capacity, which often apparently tells in favor of steam owing to the internal arrangement of coaches adopted for electrical working. Running costs are given for a number of railways, including the Mersey Railway, which is a good example for comparative purposes. Finally, the general results obtainable are discussed and illustrated by examples taken from the London, Brighton & South Coast Railway.—Lond. *Elec.*, June 21.

Installations, Systems and Appliances.

Condensers for Lightning Arresters.—A note on the application of the Moscicki condenser which is made of a glass tube with thick necks and has a chemical deposit of silver inside and out, over which is a thicker layer of copper. Such

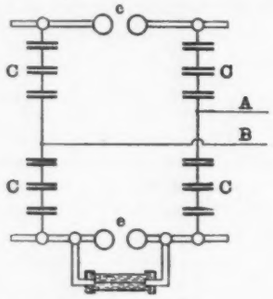


FIG. 3.—ARRANGEMENT OF CONDENSERS.

condensers are used in lightning arresters as follows: By the use of condensers it is possible to protect circuits simultaneously against induced high-frequency currents, against static charges and against excessive voltages produced by the sudden variations of the load on the machines and by the working of the switches. The principle of the working of these lightning arresters is based upon the fact that the flow through a condenser is proportional not only to the difference of potential between the two plates, but also to the frequency of the current. Consider a battery of condensers through which a current of 0.1 ampere passes to earth under the influence of the normal voltage of the line, and assuming that the frequency of the line current is 50, a current of 1000 amperes will be sent through the same battery, if the frequency of the line current is 500,000, without the voltage being any higher. Atmospheric discharges have frequencies of this kind, and the flow to earth can be enormous without the pressure in the line exceeding the normal. By arranging the in-

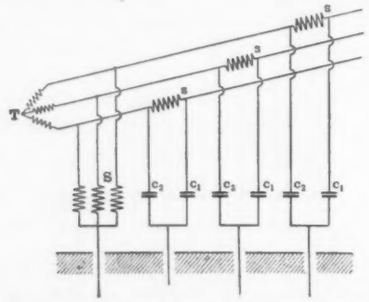


FIG. 4.—ARRANGEMENT OF CONDENSERS.

stallation, as shown in Fig. 3, where *A* and *B* are feed wires coming from a high-pressure generator having a frequency of 50, *C*, *C*, condensers, *e* the balls of the air-gap, it is possible to regulate the capacities so as to obtain in the circuit formed by the four condensers and the two air-gaps resonance currents of very high frequency, for instance 500,000 to 600,000. Now place as a shunt in one of the gaps, a resistance consisting of a german silver wire enclosed in a glass tube full of water. Let the resistance of this wire be 7 ohms. If the circuit is caused to resonate, sparks will be produced between the balls of the gap when the balls are placed at such a distance apart that the arc corresponds to an e. m. f. of 14,000 volts. Since this figure also represents the voltage at the terminals of the resistance, it follows that for a moment a maximum current of about 2000 amperes is produced in the resistance. This maximum exists, however, only during an exceedingly short time. The cases in which it is impossible to find on the apparatus of the circuit (generators or transformers) a sufficient number of neutral points for completely protecting it are very rare. In such cases the method shown in Fig. 4 is adopted, which consists of inserting a choking coil branched directly between the conductors of the circuit. The working will be the same, but the apparatus will be more expensive.

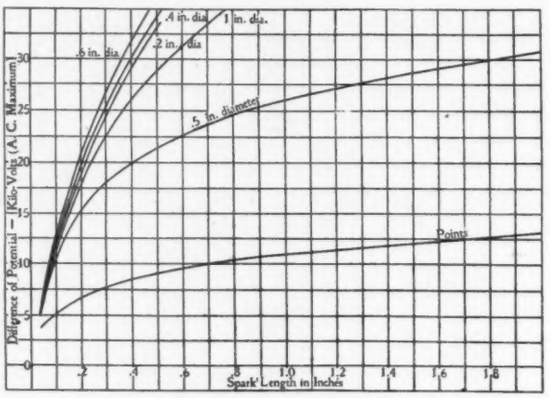


FIG. 5.—DISRUPTIVE VOLTAGES.

Condensers must be installed at each entrance to a station, but one choking coil will be sufficient to protect a circuit with a radius of from 30 km to 35 km against the static charges. —Lond. *Elec.*, June 21.

Electrophysics and Magnetism.

Dielectrics.—A. P. M. Fleming.—An article on the physical characteristics of dielectrics. The author first gives an outline of the ionic theory of electric conduction, and discusses the conduction of electricity through gases. The disruptive voltage depends to some extent on the distribution of the field which is determined by the shape of the electrodes. Since the formation and the velocity of the ions depend largely on the intensity of the field, the conductivity will increase and the voltage required for disruption be reduced as the radius of curvature of the electrodes is reduced. The relation between disruptive voltage and sparking distance for various shaped electrodes is shown by the curves in Fig. 5. Within wide limits the disruptive voltage varies directly as the pressure of

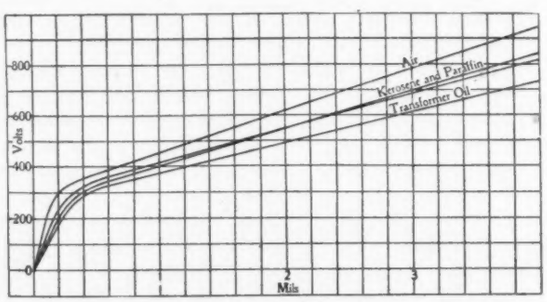


FIG. 6.—CONDUCTION OF LIQUIDS.

the gas. When, however, this is reduced to a "critical" value of the order of a small fraction of an atmosphere, the disruptive voltage increases as the pressure is diminished. This is due to the fact that sufficient ions cannot be produced from the small quantity of gas available, and disruption does not take place until the intensity of field is raised high enough for the necessary quantity of ions to be liberated from the electrode surfaces. When the spark gap is only of the order of a few mils, the disruptive voltage is independent of the pressure, but it varies with the metal used for the electrodes, and the ions supporting the conduction appear to be derived from them. The author then passes over to a discussion of the conduction of liquids and gives in Fig. 6 curves for the dis-

ruptive voltages for very short spark lengths in gaseous and liquid dielectrics, the electrodes being a plate 2 ins. in diameter and a sphere 1 in. in diameter. Finally, the conduction through solid dielectrics is discussed and the effect of temperature is shown in Fig. 7, which indicates a decrease in the resistance as the temperature increases up to about 80 degs. C. The upward bend at higher temperatures is due partly to the moisture being dried out and partly to a change in the nature of the

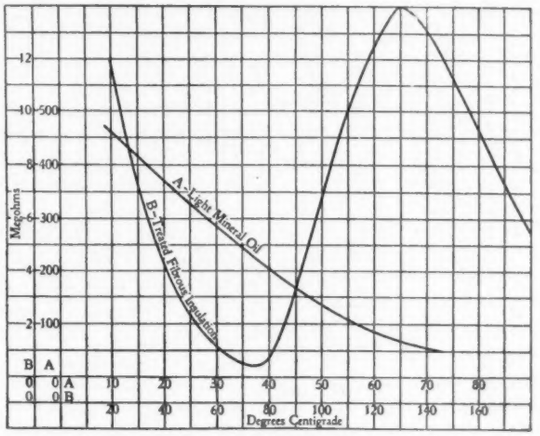


FIG. 7.—EFFECT OF TEMPERATURE ON SOLID DIELECTRICS.

material. The ultimate downward bend occurs when the material has become carbonized, and at that temperature the material is a partial conductor. Excepting when the pressure is instantaneously applied, the disruptive voltage does not vary directly as the thickness. This is indicated by the curves, in Fig. 8. (*A* electrodes, 1 in. sphere, *B* electrodes 1 in. flat plates.) The exact shape of the curve will vary according to the ventilation of the material, the cooling effect of the electrodes, the

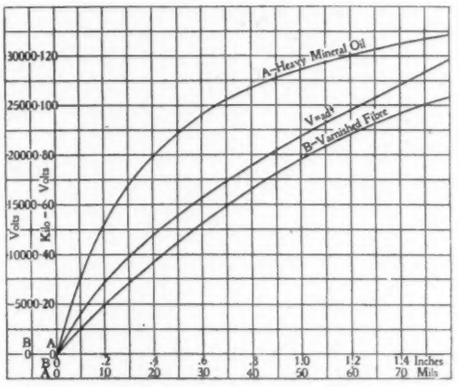


FIG. 8.—DISRUPTIVE VOLTAGES.

external temperature and the intensity of the field, which, neglecting the effect of surface discharge, will be determined by the shape of the electrodes and the thickness of the dielectrics. The law, $V = a\,d^{2/3}$, where a is a constant depending on the dielectric and d its thickness, has been suggested as giving approximately the relation between disruptive voltage and dielectric thickness.—*Elec. Jour.*, July.

Superposition of Mechanical Vibrations and Electric Oscillations upon Magnetization.—JAMES RUSSELL.—An illustrated paper on the superposition of mechanical vibrations (electric oscillations) upon magnetization and conversely in iron, steel and nickel. Vibrations may be superposed upon a constant field, or change of field may be superposed upon permanently acting vibrations. Under the former conditions, vibrations lessen those differences of magnetization to which hysteresis without vibrations has already given rise. Under the latest conditions, hysteresis loss, for instance, is increased or decreased as the fields are low or high; and in quenched nickel vibrations increase residual magnetism, when the field producing the same induction with and without vibrations is in both cases withdrawn. Such results cannot be concisely stated in terms of magnetic hysteresis, but they are subject to this condition—that vibrations increase the differential permeability in low fields, and diminish it in high fields. The effects of electric oscillations upon magnetization, when superposed under both of the above conditions, are essentially the same as those produced by purely mechanical vibrations.—Lond. *Elec.*, July 5.

Stress and Magnetization.—K. HONDA AND T. TERADA.—A very long account of experiments in which the authors first investigated the change of magnetization by applying successive stress under constant fields and further investigated the magnetization by applying the magnetizing field under different constant stresses, wherefrom they deduced indirectly the change of magnetization by stresses.—*Phil. Mag.*, July.

Inductance of Straight Wires.—K. W. WAGNER.—An article on the definition of the self-inductance of a straight wire. If an attempt is made to calculate the magnetic flux produced by a straight wire of definite length according to the Biot-Savart differential law, an infinitely large value is obtained because the application of that law to circuits which are not closed is not proper. Therefore, inductances can be defined only for loops (closed circuits) if the definition is intended to be generally valid.—*Elek. Zeit.*, July 4.

Dielectric Constant of Ice.—F. BEAULARD.—An account of measurements of the dielectric constant of, first, ice; second, mixture of water and ice; and, third, melted ice. The results are as follows:

Ice from pure water	K = 1.455
Mixture of ice and water	K = 1.987
"	2.280
"	2.477
"	2.586
Water (near 0 deg.)	K = 3.072

The dielectric constant of ice is approximately of the magnitude of the square of the refractive index, according to Maxwell's law.—*Comptes Rendus*, April 29; Lond. *Elec.*, June 21.

Magnetic Rotation.—R. W. WOOD.—An account of an experimental investigation of the magnetic rotation of sodium vapor at the D lines.—*Phil. Mag.*, July.

Radioactivity.—G. A. SCHOTT.—A note on the explanation of the radioactivity of radium. The theories of radioactivity may be conveniently divided into two classes, first, the theories which assume the positive charge of the atom to be at rest, while the negative charges are also at rest (theories of Lord Kelvin), or are in motion (theories of Nagaoka and of J. J. Thomson); second, theories which assume both the positive and the negative charges to be in motion with high velocities. Theories of the first class ascribe the energy of alpha and beta particles to potential energy stored in the atom, at any rate for the greater part; those of the second class attribute a considerable portion of it to kinetic energy existing as such in the atom. In the present note the author emphasizes that these two classes of theories lead to essentially different conclusions as to the proportion in which the energy emitted by radium is distributed between alpha and beta particles so that they can be subjected to the test of experiment. As far as experimental evidence is available it is in favor of the second class of the above theories. This brings up the problem of constructing a system of positive and negative charges, both of which are in rapid orbital motion, and which shall be sufficiently stable and permanent to exist for long periods, and yet capable, as it were, of occasional lapses, from stability, producing a sudden explosion with expulsion of positive and negative charges.—*Phil. Mag.*, July.

Radioactivity.—An account of the following papers presented at the recent meeting of the German Bunsen Society concerning radioactivity and the hypothesis of atomic disintegration: Voller spoke on radioactivity; W. Marckwald on the chemical behavior of radioactive substances; G. Meyer on the formation of helium from radioactive substances; F. von Lerch on the nature of radioactive radiation; O. Hahn on the hypothesis of atomic disintegration; M. Levin on some consequences of the hypothesis of atomic disintegration; F. Heinrich on the radio-

activity of air and of spring waters.—*Zeit. f. Elektrochemie,* July 5.

Radiation.—An account of an investigation of the secondary radiation from a plate exposed to the rays from radium.—*Phil. Mag.,* July.

Alpha Rays.—E. Meyer.—A paper on the absorption of alpha rays by metals. He maintains the results of his former paper. It is not necessary to assume a diffuse defraction of the rays in metals for the explanation of the absorption of the alpha rays in metals.—*Phys. Zeit.,* July 1.

Electronic Theory.—A. Schidlof.—A mathematical paper on the integration of the Lorenze-Poincaré potential equations of the electronic theory and a paper by G. A. Schotte on the foundation of the electronic theory.—*Phys. Zeit.,* July 1.

Canal Rays.—J. Stark.—A paper on the conditions for the photographic observation of the Doppler effect with canal rays.—*Phys. Zeit.,* June 15.

Electrochemistry and Batteries.

Ionisation Theory.—W. Sutherland.—A highly theoretical paper proposing a modification of the electrolytic dissociation theory. In a previous paper the author had shown that the theory of the conductivity of electrolytic solution is complicated by the entry of the dielectric capacity of the solvent and of the ions. In the present paper he shows that the subject is still further complicated by the operation of a new type of viscosity, but that when the electrical and dynamical complications are taken into account there emerges an ideally simple result, namely, that the ionization of all ordinary electrolytic solutions, gaseous or other, is complete at all concentrations. The fraction which is currently called the degree of ionization (or of electrolytic dissociation) really originates in a resistance which the ions offer to one another's motion because of their forming with the solvent through their electric action on one another a medium which offers a special vicous resistance to the motion of each individual ion. This is one new type of viscosity of electric origin. But the charge of each ion causes electric induction through the surrounding solution, and with this is associated a second new type of viscosity, also of electric origin. These, with the ordinary viscosity of the solution give three resistances to the motion of an ion. When the sum of these is equated to the electric driving force, a formula is obtained for the molecular specific conductivity which has been tested by the author with experimental results of very wide range, especially those of Walden for non-aqueous solutions, those of Kohlrausch for aqueous solutions at ordinary temperatures, and those of Noyes and Coolidge for aqueous solutions at high temperatures. The author thinks that the current theory of solutions will need to be entirely rewritten. The idea of partial ionization, while it can give a formal qualitative account of the chief phenomena of solutions, being dynamically wrong, cannot furnish a correct quantitative correlation of their properties. The theories of the raising of the boiling-point and the lowering of the freezing-point of solutions will have to be put upon a sound molecular dynamical basis.—*Phil. Mag.,* July.

Units, Measurements and Instruments.

Demonstration of the Angle of Phase Difference.—H. Starke.—A description of a stroboscopic method for demonstrating directly in the lecture room the angle of phase difference between two alternating currents of the same frequency. The principle is as follows: On the axle of a small synchronous motor supplied with alternating current a circular black disk of cardboard of a diameter of 15 cm to 20 cm is mounted, on which a thin strip of white paper in the direction of a radius is pasted. When continuously lighted, the rotating disk appears uniformly white. If, however, the lighting is done by intermittent flashes of light which occur with the frequency of the alternating current so that a new flash appears every time after the completion of a full period, the white radial strip is seen to rest invariably at one and the same place. These intermittent flashes of light may be easily produced by the discharge sparks of a Leyden jar, which is connected to an induction coil operated by the same alternating current. Since the sparks occur after each half period, two radii are observed opposite to each other in the circle so that one white diameter appears on the black disk. According to the phase of the spark, this diameter has a different position, so that this phenomenon may be easily used to illustrate phase differences by showing directly the angle of phase difference.—*Phys. Zeit.,* June 15.

Motion of Flames Produced by Electricity.—K. Marbe.—A description of a number of experiments, the first of which is as follows: A battery of 124 volts is connected to a circuit which contains an air-gap of 5 mm between two horizontal electrodes (brass or carbon electrodes). Within the air-gap an acetylene flame burns perpendicular to the electrode plane; it may touch the electrodes, although this is not necessary. When the circuit is closed the flame shows a visible displacement towards the negative pole. When the circuit is broken again, the flame comes back into its original position. This phenomenon may be graphically represented by passing a paper strip over the flame, the brass or carbon electrodes being placed at right angles to the direction of the motion of the paper. If instead of the closing and breaking of a direct current, an alternating current is employed, a continuous motion of the flame is visible on the paper strip, one motion corresponding to each alternation, so that the frequency may be easily determined by this method.—*Phys. Zeit.,* June 15.

Conductivity Bridge.—R. Appleyard.—An abstract of a (British) Physical Society paper. The author exhibited a direct-reading conductivity bridge for testing rods of steel or other material, where there is considerable range of conductivity between successive specimens and where it is necssary to eliminate the resistance of end contacts. The instrument is provided with two scales and with corresponding sliders. By setting one of the sliders with reference to its scale, compensation is made for any small difference of diameter or of mass between the standard rod and a test rod. The second slider is then adjusted to the position of the balance, and the conductivity is read off the second scale as a percentage, according to Matthiessen's standard, or in terms of any desired unit. All arithmetic is avoided and the results are obtained at the rate of two or three a minute. The author gave the equation for the calibration of the scales, and showed that the errors involved by the use of the compensation scales were for practical purposes negligible.—Lond. *Elec.,* July 5.

Meters.—An announcement of the German Reichsanstalt concerning direct-current motor-meters of the Bergmann Electric Company, which have been admitted for testing and calibration.—*Elek. Zeit.,* July 4.

Telegraphy, Telephony and Signals.

Continuous Electric Oscillations by Means of the Electric Arc.—J. A. Fleming.—An abstract of a (British) Physical Society paper on the Poulsen arc as a means of obtaining continuous electric oscillations. The author showed and described an apparatus for forming an electric arc in an atmosphere of coal-gas between a carbon rod kept in slow rotation and a cooled copper anode, the arc being formed in a magnetic field of 600 to 1000 c. g. s. units. The arc was supplied with a continuous current at a pressure of from 400 to 500 volts. A condenser of 0.003 mfd capacity in series with an inductance of 300,000 cm was shunted across the arc, and experiments shown prove the existence of high-frequency oscillations in the condenser circuit. A long resonance helix of insulated wire was then joined to the condenser circuit, and when tuned to it created a powerful high-frequency field round it, in which vacuum tubes glowed brilliantly. By vibrating or rotating a Neon vacuum tube of spectrum type near the helix and showing that the band or disk of light was cut up by dark spaces, Fleming supported the contention that the oscillations so produced are not absolutely uninterrupted, but cut up into groups. Another experiment was shown to confirm this. The oscillations produced by the arc in one circuit were caused to create secondary oscillations in another circuit in which was a condenser shunted by one of Fleming's oscillation valves, and a telephone. The valve rectifies the secondary oscillations, and if they were absolutely continuous the telephone would be

traversed by an uninterrupted direct current. But, as a fact, a discontinuous sound is heard in the telephone which can arise if the primary oscillations come in batches or groups. Fleming then gave some figures showing the kind of values obtained for the efficiency of transformation of continuous to oscillatory current by the arc, and compared them with similar measurements for the spark method. He concluded with some discussion of the modus operandi of the metal-carbon arc in the production of oscillations in a shunt circuit containing capacity and inductance. In the first case the curve was much steeper than in the second. This implied that the same amount of energy could be conveyed to the oscillatory circuit by means of a condenser of smaller capacity and therefore give higher frequency. This was confirmed by the fact that the curve for small currents in the case of the carbon arc in air was steeper than for larger currents, and it was found that a Duddell carbon arc could give high-frequency oscillations when actuated with small currents. He thought that there was still much work to be done before the whole of the phenomena of the oscillatory arc would be understood. In the discussion, W. Duddell pointed out that it is possible to obtain continuous oscillations with the musical arc using high frequencies.—Lond. *Elec.*, July 5.

Submarine Loaded Cable.—EBELING.—A long and fully illustrated paper giving details of the telephone cable loaded with Pupin induction coils and laid in the Bodensea. The chief result of the work is the proof that lead cables may be laid successfully in depths of several hundred meters, and that the use of Pupin induction coils is possible with submarine cables. In the discussion which followed, Breisig spoke well of the method of Kramp of increasing the self-induction in a continuous manner. Raps pointed out that the Pupin coils are relatively inexpensive, and could not increase very much the total cost while, on account if its smaller dimensions, the Pupin cable is much cheaper than any other submarine telephone cable. The great expense incurred in the laying of the cable in the present case was due to the fact that the cable had to be laid at greater depths than usual.—*Elek. Zeit.*, July 4.

Miscellaneous.

World's Fair.—An editorial discussion of the question whether a World's Fair in Berlin or Frankfurt or in some other German city would be a benefit to the German electrical industry. This is answered strongly in the negative. It is said that the expense would be very high, while no corresponding returns could be expected. A young industry has an interest in exhibiting its products so as to attract customers, but the German electric industry is said now to be so well established that it does not need to attract customers by exhibitions. The industries of other countries are said to compete with the German electrical industry not with respect to quality, but by furnishing cheaply and more quickly standard machines. "No world's fair could do anything against that and experience must gradually convince the consumer that the better product is in the end the cheaper one." It is finally said that the arrangement of a world's fair in Germany would certainly offer the cause for a strike of the socialist workingmen.—*Elek. Zeit.*, June 20.

British Municipal Electrical Association.—From the annual report for the year ending June, 1907, it appears that the membership of the association now stands at 388, made up of 152 committee members, 166 chief electrical engineers (members), two honorary members and 68 assistants. The new president is H. Talbot, of Nottingham.—Lond. *Elec. Eng'ing*, July 4.

Raw Material Supply.—P. H. KNIGHT AND C. E. SKINNER.—A paper read before the American Society for Testing Materials on the system of purchasing the raw materials for a large manufacturing company (in this case the Westinghouse Company). The list of raw materials comprises in this case not less than 850 items.—*Elec. Journal*, July.

L'Industrie Electrique.—This French journal of the late E. Hospitalier is now edited by H. Armagnat.

BOOK REVIEWS.

LICHTSTRAHLUNG UND BELEUCHTUNG. By Paul Hogner. Braunschweig: Friedr. Vieweg & Sohn. 66 pages, illustrated. Price, 3.50 marks.

The book is a brief treatise on illumination of surfaces, prepared for the use of illuminating engineers. It contains many useful numerical tables and illumination-constants. It is particularly directed to the use of electric lighting. The treatment is mathematical. The standard of luminous intensity is the hefner and the unit of illumination selected is the lux, or hefner-meter.

LA TELEGRAPHIE SANS FILS. Par R. De Valbreuze. Paris: Eclairage Electrique. 169 pages, 129 illustrations.

This is another of the many works on wireless telegraphy written for the general reader. The 169 pages contain much clear exposition and many instructive diagrams, but are nowhere ornamented with mathematical symbols of any kind. Any one acquainted with the elements of electricity can derive much profit from the reading of this *brochure*.

DIE VERBRENNUNGSKRAFTMASCHINEN IN DER PRAXIS. By H. Neumann. Hannover: Dr. Max Janecke. 320 pages, 138 illustrations. Price, 4 marks.

The author has collected into this little volume a mass of practical information concerning different types and constructions of internal combustion engines. Little or no attention is given to their thermodynamic theory, but in place thereof is a large number of small machine drawings showing the actual arrangement of the parts. The first section of the book is a short introduction, partly historical. The second section divides engines into classes. The third deals with the assembling and general construction of engines. The fourth treats of fuels. The fifth describes the installing of engines. The sixth gives an account of various modern types of engines. The seventh discusses the practical operation of such engines and the special difficulties they may present. The eighth concerns the testing of engines and the ninth the costs of operation and installation. The book will be of value to all students of internal combustion engines who are interested in German practice.

Meter Testing.

BY OTTO A. KNOPP.

The editorial on "Evolution in Meter Testing" which appeared in the ELECTRICAL WORLD of June 8 has led the writer to think that an account of a method of meter testing which has been developed in Oakland, Cal., might be of interest to readers.

The Oakland Gas Light & Heat Company formerly used the well-known method of using an indicating wattmeter and a stopwatch which was discarded and a specially designed master-meter for 100-500 volts and 5-100 amperes, both direct and alternating, was introduced. The instrument requires but one man for its operation and has been used to good advantage. The use of the watt-hour meter or master-meter eliminates two difficulties. First, the difficulty of averaging or integrating the reading on an indicating meter over a certain observation time. Second, the difficulty of getting the accurate time of observation with a stopwatch, which is apt to have considerable zero and scale error.

The principle of the new test method is based upon the old indicating method, but to a predetermined load is applied to the meter of a value to cause a correct meter to complete one, two or three revolutions in 1/100 of one hour. A stopwatch having a hand which makes a complete revolution in 1/100 of an hour is provided. If the meter is correct, the watch will just complete one revolution, or return to the starting point or zero point, thus cutting out all zero errors and scale errors. If the meter is not correct, the stopwatch will give the percent-

age correction factor of the meter, since the face of the watch is divided in hundredths and tenths thereof.

As each revolution of a meter represents a certain number of watt-hours, called the watt-haur calibrating constant, usually written on the disk of the meter, we obtain the load on any meter by dividing the time in millihours for one revolution into the calibrating constant of the meter. Thus we get for each meter the load in kilowatts, which causes it, if correct, to make one revolution in ten millihours, by dividing the watt-hour calibrating constant K by ten.

For testing an average residence meter, for instance, a 10-100 induction meter, with a calibrating constant of .6 watt-hours, we apply $100 \times .6$ watts or 60 watts. After counting one revolution with the millihour stopwatch, the watch will give the correction factor; that is, if the meter was correct, the watch will have returned to its starting point or show one revolution or the correction factor one. If the meter is slow, the watch will show perhaps 1.05 revolutions, which means that the correction factor is 1.05. If fast, the watch will show less than one, perhaps .96 revolutions, which means a correction factor of .96.

For a heavier load test, we apply, for instance, 10×60 watts and take time for 10 revolutions. Since each 60 watts gives us one revolution, 600 watts will give us 10 revolutions for one revolution on the watch.

The millihour stopwatch thus shows in each case the correction factor. All calculations are avoided by this method, as has been shown, except a multiplication with 100. Load chasing is done away with as the load is applied to the meter with the testing instrument. Integrating or averaging of the load is eliminated as the load is kept steady under fluctuating voltage by means of a regulating resistance. Stopwatch errors are cut out in the final adjustment, as the watch is caused to make complete revolutions only. Any dollar watch will make complete revolutions with an accuracy which is far in excess of the accuracy of the best standard indicating wattmeter.

There are few chances for spoiling the instrument and burning it out, as it is a watt consuming instrument and has the full potential across its terminals, which is not the case with a wattmeter, or the watt-hour meter. In practice this quality proved to be of immense value, as instruments handled by new and inexperienced men have never been burnt out, as has frequently happened with the old instruments, even with experienced men.

The weight of this new outfit is very small. For instance, a portable outfit for loads from 25-600 watts and 110 and 220 volts, for testing residence and other small meters, primary meters, secondary meters with current transformers, etc., weighs only about 7 lbs. This is a noteworthy improvement when compared with the weight of a portable master-meter which is approximately 12 lbs. to 15 lbs., and with an additional loading device often up to 25 lbs.

Electric Ventilating Fans.

At sea where the breezes blow free, the old-time ventilator funnel is giving way to the compact and adaptable fan blower. A wonderfully complete installation was made on the recently completed United States battleship "New Hampshire," which is equipped with no less than 25 electrically-driven Sturtevant fans of varied types and sizes. These are scattered all over the ship, being applied for boiler and engine room ventilation, for renewing the air in cabins, mess rooms and holds; in fact, they have been placed with the utmost ease just where they were wanted. The small fans with cast-iron casings are driven by bi-polar motors, while the larger fans of steel-plate construction have four-pole or eight-pole motors. All of the fans are so made that they may be adjusted to discharge in any direction by slacking the nuts and turning the casings. For fire room service the motors are of the enclosed type to prevent damage from dust in the air; for general ventilation they are of the semi-enclosed or of the open type.

National Electrical Contractors' Convention.

The exercises connected with the meeting of the National Electrical Contractors' Association in New York City last week were continued along the lines of the programme given in these pages, and the convention closed very successfully. The intense heat of the three days did not hinder the work or pleasure in any way, and every event was taken up and disposed of with the utmost vim and enthusiasm. One great hit with the "vaudeville extravaganza" given at the Waldorf banquet on Wednesday night, the liberetto being from the witty and facile pen of "Gilpin, V. C.," otherwise the well-known supply agent, etc., of that name. The time and scene of the play were "dated ahead" to 1930, but the personages and dialogue were vital of this present year of grace.

In "Not Yet, But Soon," some of the leading figures of the electrical world were satirized. James Armstrong Tucker, played by George H. Watson, showed James R. Strong, the New York contractor, the association president, who was not content with a beggarly $2,000,000 profit. The electrical engineer came to him pleading for a bid. To reach his lowest bid Tucker used his calculating electrical machine. But a labor leader hiding behind the machine had fouled its action, with the result that the bid was put in at $91,000,000, while Miss Richardson Syracuse—a reference to Miss Rose Richardson, of Syracuse, the only woman prominently in the electrical contracting business—who had bid $81,000,000, got the contract. However, she had met her rival, they had fallen in love, and as a part of her dower, Miss Syracuse withdrew the winning bid, the works of the two were consolidated, and the contract was finished in union. Almost every line was a witty joke, gag or kindly "knock," and the audience was kept in a quiver of perspiring amusement.

Another notable feature was the visit to the telharmonium plant, on Thursday morning, after a brief explanation by Mr. O. T. Crosby, who, as showing the imminence of the new art, stated that one of the contractors in the association in doing work on a new large hotel on Manhattan Island, had had several thousand dollars added to his contract by the wiring for the distribution in the building of telharmonic music from the central plant.

During the week, the attendance was large, running up into the hundreds. A number of manufacturers and supply houses were represented as noted below. The Electrical World was represented by Messrs. J. M. Wakeman, G. W. Elliott and T. C. Martin.

The American Circular Loom Company was well represented through the efforts of Messrs. A. T. Clark and Oscar Hoppe, from Chelsea, as well as those of Mr. Alex Henderson, of New York, and Mr. M. King, of Chicago.

Pass & Seymour, of Syracuse, were represented by Manager Brooks, assisted by W. B. Hall, their New York manager.

The veteran F. M. Hawkins looked after the interests of the Crouse Hinds Company.

The American Conduit Manufacturing Company, of Pittsburg, had Thomas H. Bibber present speaking for the interests of its product.

Mr. J. P. Gillette, of the Gillette-Vibber Company, of New London, was present to describe its new line of specialties. Mr. Gillette will shortly make an extended trip West.

President Fullman, of the Steel City Electric Company, Pittsburg, was in attendance.

The D. & W. Fuse Company, of Providence, sent W. S. Sisson to speak for its line of fuses and cutouts.

Messrs. Garland and Hodgkinson came from Pittsburg in the interests of the Safety Armorite Conduit Company.

The India Rubber and Gutta Percha Insulating Company, of New York, was looked after by Mr. J. B. Olson, the sales manager.

R. B. Corey Company was represented by Mr. Harry C. Adams.

Mr. Frank Harrington, of the New York office, was much in evidence for John A. Roebling's Sons Company.

MR. S. B. CONDIT, JR., spoke for the Condit Electric Manufacturing Company, of Boston.

MR. HARRY WATERMAN was in earnest behalf of the Sterling Conduit.

THE DEVEAU TELEPHONE MANUFACTURING COMPANY had Mr. A. S. Deveau always on the scene.

THE HART MANUFACTURING COMPANY, of Hartford, had Messrs. Taylor and Crockett in attendance.

MESSRS. V. C. GILPIN AND RUSSELL DART represented the Alphaduct Manufacturing Company. Mr. Gilpin came in for a great amount of praise and congratulation on the success of the humorous sketch presented at the banquet, he being not only the author, but the efficient stage manager.

THE WESTERN ELECTRIC COMPANY had in attendance Mr. E. S. Keefer, who was on several committees. Messrs. Rockafellow, Oberlander and Edwards assisted him in the convention.

THE NATIONAL METAL MOLDING COMPANY, of Pittsburg, had its usual array of talent on the scene. Messrs. C. E. Corrigan, H. B. Kirkland and Charles F. Boynton were kept busy every minute looking after their friends and patrons.

MR. J. A. VAUGHAN came on from Philadelphia to look after the interests and friends of H. C. Roberts Electric Supply Company.

THE NEW YORK INSULATED WIRE COMPANY had Messrs. Hoover and Brewster in attendance.

MR. H. S. SALT was on hand in behalf of the Dale Company.

MR. JOHN H. DALE, a familiar figure at all such conventions, was absent, being on a trip to the Pacific Coast.

MR. FRANK STOUT was on hand indulging in discursive eloquence as to Frink reflectors.

THE SAFETY INSULATED WIRE & CABLE COMPANY sent Mr. A. P. Eckert.

MR. E. C. TIBBALS was present telling about the excellence of his make of switchboards and panel boards.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY sent Convention Specialist McDowell to look out for its interests.

THE CHASE-SHAWMUT COMPANY had W. S. Brown, its New York representative, at the meetings.

The interests of the WIRT MANUFACTURING COMPANY, of Burrage, Mass., makers of porcelain, were ably looked after by a representative of the Steers Supply Company, 88 Maiden Lane, New York, manufacturers' agent.

Speed Regulation of Diesel Engine.

Governing of gas and gasoline engines is effected in a variety of ways, which may be grouped under two headings: the "hit and miss" method and the variable impulse system. A more accurate name for the former would be "constant impulse of variable period," which could be contrasted with "variable impulse of regular period," giving a very clear line of differentiation.

For regulation under variable load and particularly under light load, the first method gives the most economical results of all the usually employed systems of governing, but the mechanical defects introduced by it are held by some to detract from the theoretical advantages of such regulation. The principal drawback urged is the necessity for unusually heavy flywheels. After several successive "misses" there is danger of a powerful explosion action on the very slowly moving parts, which, owing to the inertia of the heavy flywheel, may produce a breakage.

The system of "variable impulse or regular period" divides itself into the method of constant quality with variable quantity of mixture, and that of constant quantity but variable quality. This system requires usually a very heavy governor, and necessitates increased compression in order to produce explosion, because the total quantity of air where admitted is frequently so small that compression falls below the ignition point.

For the same reason the method of constant quantity and variable quality is claimed to be defective. Moreover, the effect of changed fuel supply makes itself felt later, and the change cannot be controlled with sufficient exactness. When there is too much hydrocarbon in proportion to the air, combustion will be incomplete, causing unburned or incompletely consumed fuel to be exhausted, that is, thrown away, and clogging the cylinder walls, piston head, valves and ports with partially burnt carbon as soot and greasy grime. Such impurities, if not quickly scavenged out, are apt to produce preignition and back-firing by becoming incandescent. If the explosive mixture is too much diluted, it will not explode at all.

It is claimed that in striking contrast with such unreliable and uneconomical regulation is the method of governing in use on the Diesel crude-oil engine. A small flywheel governor, driven by the main shaft, controls a valve in a bye-pass pipe connected to the fuel pump, which is so arranged as to raise its maximum quantity of the fuel oil at each stroke. The quantity injected into the cylinder depends on whether the governor permits the oil to flow to the injector valve by closing the bye-pass, or whether all or a part of it is returned to the supply tank through the more or less opened bye-pass. There can never be an excess of fuel injected into the cylinder, because the Diesel principle provides for a normal large excess of air in the cylinder. There cannot be a failure to explode from insufficient hydrocarbon admixture, because there are no explosions. Whatever oil is sprayed into the cylinder is consumed as fast as it enters, the air in the cylinder being raised by compression to a temperature far beyond the ignition point of mineral oils. Thus waste by incomplete combustion is simply precluded, no matter what the degree of governing. Be the quantity great or small, there can be no variation of thermal efficiency because every particle of fuel is consumed, as is evidenced by absolutely clean cylinder walls after months of running. It is stated that a white handkerchief held in front of the Diesel engine exhaust is not colored or spotted.

In mechanical detail and in thermal dynamic effect, the Diesel governor works just as positively and as irrespective of conditions within the cylinder, as does the steam engine governor; hence its regulation is just about as close, as economical and as reliable. This engine is claimed to produce in practice almost precisely that degree of efficiency which Herr Diesel had from theoretical considerations judged to be the highest attainable, and which he had set before himself as a goal even before the first model was made.

Induction Motors in the Making of Matches.

The Diamond Match Company has installed at its Oshkosh, Wis., plant a complete alternating-current generating and induction motor equipment, all of Allis-Chalmers manufacture. The equipment consists of two 300-kw generators direct-connected to Reliance engines, a 110-kw generator direct-connected to a high-speed engine, a five-panel switchboard, 24 5-hp variable-speed induction motors and a number of constant speed machines for distribution throughout the plant, all of the apparatus being three-phase, 60 cycles and 440 volts.

The unusual feature in connection with this installation is the fact that the match machines, which have always heretofore been group-driven, will in this new plant each be driven by a 5-hp, 1200 r. p. m. induction motor, 24 machines comprising the initial installation. It was shown by careful tests that individual drive in this plant will decrease the power consumption at least one horse-power per machine by eliminating the use of a mechanical speed changer as well as the long countershafts joining the groups of machines in the older installations. The tests showed that .65 ehp is required to drive the speed changer alone; the machine proper consumes 2.5, 2.7 and 3.4 ehp at speeds corresponding to 160, 194 and 220 strokes of the cutters. Five-hp motors were, therefore, chosen as being of the proper size for the work. Speed reduction becomes necessary only during damp weather in order to allow the matches a longer interval in which to dry.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The favorable weather conditions, improved crop prospects, and the final appearance of fervent midsummer heat, have greatly stimulated retail trade, which is turning out better than was expected a month ago. Encouraging reports are received from leading commercial centers, the volume of business being exceptionally heavy for the season, and stocks are depleted by the usual clearance sales. Buyers are numerous in the large cities, preparing for an active fall trade, now that the agricultural outlook is less uncertain. Foreign commerce in June eclipsed all previous records for that month, both imports and exports rising $12,000,000 above June, 1906, which in turn exceeded all earlier years. For the last week at the port of New York, exports gained $4,420,799 and imports increased $2,879,699, as compared with a year ago. Railway earnings thus far reported for July show gains of 9.8 per cent over last year's figures. Collections are reported good, and crop developments have been quite generally favorable. With the reports that are coming in from the wheat threshing, the merchants of the Middle West are counting on a prosperous fall business, and a larger interior trade than last year, provided the corn is as good as it now seems likely to be. Iron and steel are quieter with prices tending to ease. The demand for structural material is fair; steel bars are in good demand and specifications are heavy. Business in steel rails and track material is rather quiet, and plates are being delivered more promptly. Steel manufacturers report a satisfactory volume of business coming in, taking into consideration the season, and the large volume of orders already on the books. The percentage of new business to production is somewhat lower than at the same time last year, though it is doubtful if the actual volume is much less. It is not expected, however, that the record of the last quarter, which established new high figures for earnings, will be equalled by the current quarter, or, indeed, by any like period for some time to come. Copper has again receded in price, but new business has not developed to any extent, and lower prices are looked for. Stocks are said to be quite large. The closing quotations are: 21½ cents for lake; 20¾ cents for electrolytic, and 20⅛ cents for cast copper. *Bradstreet's* reports 177 business failures during the week ending July 18, compared with 185 in the previous week and 188 in the corresponding week last year.

ENLARGING WIRE PLANT.—The occupation of five large new structures, besides the plant it already operates in Phillipsdale, is purposed by the Washburn Wire Company, which will move its entire working force from Auburn to Phillipsdale on Jan. 1, 1908, thus centralizing the efforts of the company and increasing the facilities for business. The new structures, which will cover an area of about 52,500 sq. ft., will cost considerably over $100,000. The new buildings will adjoin the present Phillipsdale plant on the banks of the Seekonk River and in close proximity to the plant of the American Electrical Works at Phillipsdale. Contracts for all but one of the five buildings to be erected have been awarded and work on the excavation for the foundations is already under way. The main building will be the wire mill, 164 ft. x 70 ft., to be constructed of brick and have a gravel roof supported by steel trusses. The machinery will be electrically driven by motors developing 500 horse-power. The rod mill will be a steel structure, with roof of corrugated iron and will be 180 ft. x 115 ft. in size. Adjoining the rod mill will be the power house, 180 ft. x 50 ft., to be built of steel and brick. The power house will have two tandem compound engines capable of developing 2000 horse-power, which will be used principally to drive the rod mill machinery. It will also contain two generators of 150 kw, direct connected; one generator of 75 kw, direct connected, and one generator of 100 kw, belted. The boiler house will be 96 ft. x 50 ft. and will contain eight horizontal boilers capable of developing 2500 horse-power. It will be of steel construction. The plans for this building also include the erection of a brick stack 150 feet high, with a 7-ft. flue. The annealing and cleaning rooms will be under the same roof, the building being 96 ft. x 84 ft., and will be constructed of brick.

WESTINGHOUSE ORDERS.—It is stated that the Westinghouse interests have secured a contract for the electrification of one of the largest British shipbuilding yards. The order calls for all the equipment necessary to electrically operate the Laing yards at Sunderland. A Mexican order has been allotted to the company by the Mexican Light & Power Company—the United States-Canadian syndicate headed by F. S. Pearson—which is expending millions of dollars in the development of electrical energy in the southern republic. Eight transformers, each having a capacity of 1000 kilowatts, are to be installed in Mexico City. The electrical energy is to be generated at Necaxa Falls, about 100 miles away, at a pressure of 60,000 volts. The energy is to be transmitted to several sub-stations surrounding the city, where the transformers will be installed. From these the power will be distributed over the city for running the street cars and lighting the city.

BALTIMORE PLANT.—According to President David E. Evans, the capacity of the plants of the Baltimore (Md.) Electric Company is to be increased 50 per cent, or from 9000 kilowatts to 12,000. The plant has already been enlarged since it was put in operation last summer, and the company is in a position to offer electricity to a maximum of 3000 horse-power in one unit if necessary. The company has the Baltimore rights to the Nernst lamp, and now has 14 men on the street after business. It has adopted the slogan "Brighter Baltimore," and, with strong financial backing already provided for and increased facilities, the Baltimore Electric Company is said to be in a position to become a powerful factor in the electric light and power field.

ROTARY TYPE BLOWERS.—Among recent sales of high pressure rotary type blowers made by the B. F. Sturtevant Company, of Boston, Mass., are the following: F. A. McCarthy Brazing Company, Boston, Mass.; McGill University, Montreal, P. Q.; Vermont Snath Company, Springfield, Vt.; General Storekeeper, Navy Yard, Brooklyn, N. Y.; Dupaul, Young Optical Company, Southbridge, Mass.; St. Louis Car Company, St. Louis, Mo.; Montreal Light, Heat & Power Company, Montreal, P. Q.; Orange Iron Works, Orange, Texas, and Wile Power Gas Company, Boston, Mass.

POWER IN CALIFORNIA.—Plans are being made by the General Electric Power Company of California for the construction of a hydroelectric plant on the Mokelumne River in central California, where a fall of 1230 ft. will be utilized. It is estimated that 69,000 horse-power can be developed, whose energy will be transmitted to all towns and cities of central California, including San Francisco. Contracts for the construction of the power plants have been awarded to the firm of Walston H. Brown & Brothers, of New York, N. Y.

GOVERNMENT INCANDESCENT LAMP CONTRACT. The Columbia Incandescent Lamp Company has been awarded a government contract for 270,000 incandescent lamps, to be supplied during the present fiscal year to the Treasury Department, Quartermaster's Department of the Army, Library of Congress and Public Printing Office.

MANUFACTURE OF MACHINERY IN JAPAN.—The Bank of France and Marine Bank of Belgium are at the head of a syndicate to supply $50,000,000 capital to extend the manufacturing industries of Japan. The syndicate is now making an investigation with a view to establishing works for the manufacture of machinery.

CONTRACT OPEN.—The Union Central Light & Ice Company, of Hubbard City, Tex., has franchises to supply Hubbard City and four neighboring towns with electricity, and has issued $25,000 in 6 per cent bonds, which are offered at 85 to any engineer or construction company that will contract to build the plant.

PRICE OF PLATINUM.—It would appear that the price of platinum has again been advanced, after having gradually declined from $37 an ounce, which was the price quoted last March, to $25 an ounce, which prevailed until the recent advance of $1. It is now selling at $26 per ounce. A company has been incorporated in London, known as the Platinum Corporation, with a capital stock of $1,500,000, to develop concessions in the platinum-bearing districts of Russia, which for nearly a century has been the producer of nearly 90 per cent of the platinum supply of the world. The decrease in price, before the recent advance, was attributable to financial conditions in Europe. Platinum sold in 1892 for less than $10 an ounce. In two years the price had risen to $18.50, and in December of that year it was $19.50. In April, 1905, it brought $20.50. It continued to advance until in February, 1906, it sold for $25. Last September it was quoted at $34. During the winter the highest price of $37 and $38 was reached.

EXPORT TRADE FIGURES.—Foreign trade for the 12 months ended June 30, 1907, is expressed in these figures:

Total exports	$1,881,078,747
Total imports	1,434,401,092
Excess of exports	$446,677,655

This total trade is about $250,000,000 over that of 1906. There is, however, a decrease from 1906 of excess of imports amounting to $70,852,122. Explanation of this is found in an increase of $94,368,122 in imports free of duty. Most of these are raw materials for use in the manufactures and afford evidence of the growth of our manufacturing supremacy. The figures given are exclusive of the precious metals, movement of which thus resulted:

Gold, excess of imports	$63,086,500
Silver, excess of exports	13,820,283
Net excess of imports	$49,266,217

Financial Intelligence.

THIS WEEK IN WALL STREET.—The stock market was narrow, professional and governed by manipulative influences, activity being confined to a few leading stocks such as the Harriman and Hill issues or Amalgamated Copper. The rise in General Electric reflected the success of the bond offering to which the first subscriptions became due, and were paid to an extent that was said to be entirely satisfactory. Following the publication of the bank statement the market became very strong, but just before the close prices eased off fractionally as a result of traders' profit taking over the week end. Western Union on a few transactions gained nearly three points on account of the settlement of the strike. The traction stocks were weak and closed at declines. On the other hand, General Electric closed at 140 being ½ point below the highest quotation of the week, and a net gain of 4⅜ points. Western Union closed at 80½, a net gain of 2¾ points, and Westinghouse at 146½, the highest price for the week and an advance of 2½ points. Both the Mackay issues are higher, 3 points for the common and ¼ point for the preferred. The curb market reflected conditions on the Exchange and showed moderate gains. The closing quotations of July 23 are given in the table.

NEW YORK.

	July 16	July 23		July 16	July 23
Allis-Chalmers Co.	10	10¼	General Electric	135¼	139
Allis-Chalmers Co. pfd.	28	25	Hudson River Tel.	—	—
Am. Dist. Tel.	20	—	Interborough Met. com.	16¼	15¼
American Locomotive	58¾	59¼	Interborough Met. pfd.	45	43
Amer. Locomotive pfd.	104	104½	Mackay Cos.	67	—
American Tel. & Cable.	75	75	Mackay Cos pfd.	65⅜	—
American Tel. & Tel.	106	—	Marconi Tel.	—	—
Brooklyn Rapid Transit.	58	56½	Metropolitan St. Ry.	—	—
Electric Boat	33	33	N. Y. & N. J. Tel.	—	—
Electric Boat pfd.	80	80	Western Union Tel.	77½	79
Electric Vehicle	—	—	Westinghouse com.	144½	145½
Electric Vehicle pfd.	—	—	Westinghouse pfd.	153	—

BOSTON.

	July 16	July 23		July 16	July 23
American Tel. & Tel.	107½	108	Mass. Elec. Ry pfd.	—	57
Cumberland Telephone.	—	—	Mexican Telephone.	—	2
Edison Elec. Illum.	210	211	New England Telp.	111	110
General Electric.	—	—	Western Tel. & Tel.	—	—
Mass. Elec. Ry.	17	16	West. Tel. & Tel. pfd.	70	—

PHILADELPHIA.

	July 16	July 23		July 16	July 23
American Railways.	48½	48	Phila. Electric.	8⅛	8¼
Elec. Co. of America.	9¼	9⅛	Phila. Rapid Transit.	23¼	22½
Elec. Storage Battery.	51	51	Phila. Traction.	—	94¼
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	July 16	July 23		July 16	July 23
Chicago City Ry.	—	160	National Carbon.	—	72½
Chicago Edison	—	145	National Carbon pfd.	—	112½
Chicago Subway	—	—	Union Traction.	—	—
Chicago Tel. Co.	—	105	Union Traction pfd.	—	—
Metropolitan Elec. com.	—	22			

WESTINGHOUSE REPORT.—The annual report of the Westinghouse Electric Manufacturing Company for 1906 shows earnings $33,026,240 for the year ended March 31, with net manufacturing profits of $4,179,575. The net income surplus was $2,767,963, and the gross surplus is now $15,414,676. The valuation of property and plants increased during the year $1,939,896 to $12,570,073. It is evident from the report that the company had not felt, up to the close of March, at least, any of the industrial reaction which has been evident in other lines of business. Among other signs of the great increase in business is the growth of the pay roll, exclusive of the selling organization, to 18,386 men, a gain during the year of 3681 men. The year's orders totaled $34,175,548, against $24,939,602 in 1905-1906. Vice-president Herr makes this comment on the position of the company's business: "It is fortunate for our industry that the steam railroads are moving with deliberation in the matter of electrification, not only that the best types for given conditions shall be determined upon, but owing also to the fact that were the business to come at once in any considerable volume our facilities would be unequal to cope with the demand, occupied so fully as they are with already established lines. The very magnitude of the steam railway field will involve a great amount of business even if the railroads go about the work of electrification slowly." The above does not include the orders of the Bryant and Perkins companies, the R. D. Nuttall Company or the Sawyer-Man Electric Company, now the Westinghouse Lamp Company, which for the fiscal year 1906-7 amount to $4,075,671. That the Westinghouse Electric Company loses very little on account of bad debts is evident from the fact that deductions from the above shipments by reason of bad debts amounted to approximately one-tenth of 1 per cent. The policy has been to conduct the business of the Westinghouse Company on a strictly cash basis.

BELL TELEPHONE.—Advices from Boston state that up to the end of last week the stockholders of the American Telephone & Telegraph Company had subscribed for 95 per cent of the recent issue of $21,925,000 of new stock. On this stock $50 per share is payable July 25, and the second payment of $50 per share is due Oct. 25. President Vail is confident that the entire issue will be taken by the stockholders as the five per cent who have not already taken their new stock probably represent many stockholders who are abroad and who were not immediately accessible when the notices were first mailed to the shareholders. It is probable that the company will permit these stockholders to take their pro rata apportionment if they so desire. President Vail is receiving many congratulations by reason of the success of the new stock issue, which was made at a time when money conditions were very strained and when many wise-acres prophesied its dismal failure. As to general conditions, Mr. Vail says: "I have not yet discerned any evidences of a trade reaction. Our business is good, and in net results to the company fully up to that of a year ago. We are striving now for net results and are not seeking to roll up big gross totals which, while they look good, generally mean heavy operating costs. If the business interests of the country would seek to do a little less business and do it a little better and more economically the whole business and money situation would be greatly improved."

CHICAGO TELEPHONE.—At a meeting of the Chicago Telephone Company, it was decided to issue $4,000,000 of new capital stock, thus increasing the outstanding amount to $18,000,000. The company's authorized capitalization is $20,000,000. The 40,000 shares of new stock are offered to stockholders of record at par, in the ratio of one share for each three and one-half shares of stock now held. Subscriptions and assignments of rights must reach the office of the treasurer on or before Aug. 19, 1907, and 25 per cent of the amount of the subscription must be paid not later than that date. The next 25 per cent must be paid by Nov. 5, 1907, and the remaining 50 per cent by Feb. 10, 1908. Any shares unsubscribed for or not paid for, may be sold by the directors or executive committee, and the proceeds paid into the treasury of the company. The American Telephone & Telegraph Company, which owns more than 53 per cent of the Chicago company's capital, will take more than $2,000,000 of the new stock.

DIVIDENDS.—A semi-annual dividend of $2.50 per share will be paid Aug. 1 to holders of preferred shares of Omaha Electric Light & Power Company. Directors of the Automatic Electric Company have declared the regular quarterly dividend of 2 per cent, payable Aug. 1. Directors of the American Light & Traction Company have declared a quarterly dividend of 1½ per cent on the common stock. This is at the rate of 6 per cent per annum, and is an increase of 1 per cent per annum over the dividends heretofore declared on the common stock. They also declared the regular quarterly dividend of 1½ per cent on the preferred stock. Both dividends are payable Aug. 1. Directors of the Twin City Rapid Transit have declared the regular quarterly dividend of 1¼ per cent on the common stock, payable Aug. 15. Directors of the Guanajuato Development Company have declared the regular semi-annual dividend of 3 per cent on the preferred stock. Directors of the American Graphophone Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Aug. 15. Directors of the Butte Electric & Power Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable Aug. 1. Directors of the Montreal Light, Heat & Power Company have declared a quarterly dividend of 1½ per cent, payable Aug. 15, placing the dividend on a 6 per cent per annum basis. The company had been paying 5 per cent per annum for two years. The directors of the Western Telephone & Telegraph have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable Aug. 1. Directors of the J. G. Brill Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock and 1 per cent on the common stock. The preferred dividend is payable Aug. 1. The common dividend is payable Sept. 2. Directors of the North American Company have declared the regular quarterly dividend of 1¼ per cent on the capital stock, payable Sept. 2. Directors of the Chicago Edison Company have declared the regular quarterly dividend of 2 per cent, payable Aug. 1. Directors of the Multiphone Operating Company have declared the regular monthly dividend of 1 per cent, payable Aug. 1. Directors of the New York & Queens Electric Light & Power Company have declared the regular semi-annual dividend of 2½ per cent upon the preferred stock, payable Aug. 10.

CHICAGO EDISON MERGER.—Advices from Chicago of July 15 announced definite plants for the consolidation of the Chicago Edison and the Commonwealth Electric companies. The involve the formation of a new corporation, with a capitalization of $30,000,000, to be known as the Commonwealth-Edison Company, which will succeed to the business of the two big companies now controlling the franchise rights for the manufacture, sale and distribution of electric energy for lighting and power purposes in Chicago. Resolutions have been passed increasing the capitalizations of the Chicago Edison and Commonwealth companies to $15,000,000 each. The new stock of the Edison Company will be sold to stockholders of record Aug. 31, 1907, at par in the ratio of 10.20 per cent of their present holdings, which is to be paid for in five installments, as follows: Sept. 10, 1907, 5 per cent; Nov. 1, 1907, 20 per cent; Feb. 1, 1908, 25 per cent; May 1, 1908, 25 per cent, and Aug. 1, 1908, 25 per cent. The full $15,000,000 of Chicago Edison stock is to be exchanged for stock in the Commonwealth-Edison Company equally at par. The $15,000,000 of capital of the Commonwealth Electric Company is understood to have been pledged in whole or part by its holders as security for the payment of the gold mortgage bonds of the Edison Company to the amount of $6,000,000 outstanding. An adequate amount of the new company's shares will be held in the treasury to secure the mortgage.

BALTIMORE CONSOLIDATED REPORT.—The annual meeting of the stockholders of the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., was held on July 1. The reports indicated that the output of electric energy shows a heavy increase and the output of gas a substantial one. The results of the year were as follows: Net income above operating expenses, $1,711,000; fixed charges, $1,081,000; net earnings, $630,000. Considerable interest was shown at the meeting in the facilities provided during the year to take care of the growing business. In the gas division 18.9 miles of new mains were run and 6,355 new services installed. The Westport electric power plant, which commenced operation on June 23, 1906, is now carrying about 80 per cent of the total load of the electric division and during the ensuing year this will be increased by the shutting down of other stations. Plans for the erection of an addition to this station were announced. These plans provide for a plant to house 72,000 horse-power. One-third will be erected this year and there has been ordered a turbo generator of 7,500 horse-power, with boilers and necessary equipment. The attention of the stockholders was call to the contract closed with the McCall Ferry Power Company, for electrical energy from the Susquehanna River.

NEW HAVEN LIGHTING STOCK.—The directors of the United Illuminating Company, of New Haven, Conn., have decided to issue $200,000 of the $500,000 new stock, authorized last March for the purpose of securing funds to pay for laying the underground conduits through some of the streets in the center of the city. The work is now in progress. The new stock will be offered to holders of record July 1 and will be disposed at par, $100 a share, at the rate of one new share for each five shares of old stock held. Subscriptions will be accepted only for one or more full shares. Subscriptions under holding that are not multiples of five can be adjusted by the purchase on sale of rights which will be handled by local investment brokers. It was expected that the directors of the company would issue at one time the total of $500,000 stock authorized, but as action in this regard is left to their discretion, it is now said issues will be made from time to time when the company is in need of funds for its new work.

LONGING LONG ACRE.—It would seem that the Long Acre Electric Light & Power Company, of New York, is longing and aching to butt into the gas field as well as the electric. It is understood that the Long Acre Company intends applying to the Public Service Commission for the First District for permission to begin the manufacture and distribution of gas. Should the company receive the consent of the commission, upon making application, it is understood that it will at once begin the manufacture of gas. Gas engineers express themselves as confident that the Long Acre company, if it enters into competition with the Consolidated Gas Company, will sell gas at a lower rate than that charged at present. When the fight is over and one side or the other is vanquished the price of gas will again soar. Although the Long Acre Company has franchises permitting it to manufacture and distribute both gas and electricity, it cannot engage in the manufacture and distribution of gas before obtaining the consent of the Public Service Commission, as provided in Section 68 of the Public Utilities Law.

GENERAL ELECTRIC FINANCES.—The first instalment of 50 per cent on the $13,000,000 five per cent convertible 10-year bond issue of the General Electric Company was payable July 20 at the offices of the Farmers Loan & Trust Company. According to representatives of the General Electric Company the issue is a complete success. The second payment of 50 per cent falls due on Jan. 20, 1908. Including fully paid up subscriptions, the General Electric will have between $7,000,000 and $8,000,000 additional cash available for extensions and other purposes. In spite of reports of a slowing up in business, the new orders of the General Electric Company continue at the rate of between $70,000,000 and $75,000,000 a year. The business of the company for some time past has been averaging the same as in the first quarter of the year. There have been no developments that would indicate a falling off in the business of the General Electric Company, but representatives of the corporation would not be surprised to witness a moderate slowing up before the close of the year.

WESTERN ELECTRIC EARNINGS.—It is reported from Chicago that the Western Electric Company has paid off this year $6,000,000 of the floating debt, which at one time last year amounted to $20,000,000, and it is prepared to make a further reduction. Earnings this year are estimated at $5,000,000 monthly, on the average, which compares with similar results a year ago, though the average for last year was $800,000 a month more, due to the extraordinary rush the last half of 1906 The volume of new business suggests contraction, but with the economies effected, the net this year may quite possibly be equal to that of 1906.

HAVANA TROLLEYS.—A cable dispatch from London, of July 11 says: "At a meeting of the United Railways of Havana here to-day the shareholders unanimously approved the scheme for the increase of capital necessary to acquire a controlling interest in the Havana Central Railway Company."

GENERAL NEWS

Construction News.

ATHENS, ALA.—The City Council is contemplating installing another dynamo in the municipal electric lighting plant, and is now receiving bids.

CALERA, ALA.—Arrangements are being made for the construction of an electric lighting plant in this place. A site has been purchased on Front Street and Montgomery Avenue, and franchises have been granted by the authorities. The company contemplates building an ice plant in connection with the electric plant. P. J. Jeminez is interested in the project.

DECATUR, ALA.—The Decatur Light & Power Company is considering the question of making improvements and extensions to its plant.

ENSLEY, ALA.—The City Council has granted a franchise to J. J. Walker, H. S. Meade, B. R. Pegram and associates to build a street railway in this city.

CHICO, CAL.—The Pacific States Telephone Company has commenced work on the reconstruction of its local system, which, when completed, will cost about $85,000.

COTTONWOOD, CAL.—James Barry and Charles Tozer, of this place, have filed a claim on 10,000 miner's inches of water of Beegum Creek and are planning to erect a dam at Beegum.

LOS ANGELES, CAL.—Judge Ellsworth has dissolved the restraining order recently issued against the directors of the Owens River Water & Power Company, the matter having been settled outside of court. The city of Los Angeles has bonded itself for the sum of $23,000,000 to purchase the holdings of the Owens River & Water Power Company and develop a water supply.

NAPA, CAL.—Application has been made to the City Council by W. J. Lindow for a franchise for a term of 25 years to erect and maintain poles and wires for the transmission of electricity for lighting and power purposes on the public streets in this city. Bids for the above franchise will be received by the city clerk until Aug. 6.

OROVILLE, CAL.—The Western Power Company, which is erecting a large power plant at Big Bend, is building an electric railway to assist in the work. Electricity for operating the road will be furnished by the Bay Counties Power Company.

OROVILLE, CAL.—It is stated from authentic sources that the Pacific Gas & Electric Corporation will soon resume the work of developing the French Creek power plant. Nearly four years ago the company spent a large amount of money in surveys, road building and in purchasing water rights, machinery, etc., with the object, it was said, of establishing a large power plant on French Creek, a tributary of the North Fork, about 28 miles from Oroville. The plant as originally proposed was to have a capacity of from 16,000 to 20,000 horse-power, but the new project is said to be of much greater magnitude.

PASADENA, CAL.—C. C. Glass, manager of the municipal electric light plant, has submitted a report to Mayor Earley on an underground distributing system, in which he estimates the cost of installing conduits for the electric lighting wires in the fire district, which comprises the business section in general, at $72,744.

SAN DIEGO, CAL.—The South Coast Land Company has been awarded a franchise by the Board of County Commissioners to erect poles and wires for the transmission of electricity along certain streets and highways in the county.

SAN FRANCISCO, CAL.—The board of directors of the Pacific Gas & Electric Company has voted to levy an assessment of $3,000,000, or $10 a share on the stock of the shareholders for rehabilitation and improvement purposes.

SAN LUIS OBISPO, CAL.—The San Luis Obispo Gas & Electric Company is contemplating replacing its 100-kw, single-phase generator with a three-phase machine. B. F. Pearson is manager.

PUEBLO, COL.—At a meeting of the directors of the Canon City, Pueblo & La Junta Railway & Power Company it was decided to commence at once the work of building and equipping an electric interurban railway from Canon City to the Kansas State line. The following named officers were elected: Alfred E. Bent, of Lamar, president; George D. Kendall, of Pueblo, secretary; F. E. Pastorius, of Colorado Springs, treasurer; Andrew J. Behymer, of Elwood, Ind., general manager.

HARTFORD, CONN.—The Hartford Electric Light Company is making arrangements to build a large addition to its boiler plant at Dutch Point. The building will be equipped with two Hornsby boilers of 2500 horse-power each, which will increase the capacity of the plant nearly 60 per cent.

NEW BRITAIN, CONN.—Plans are being made by the Consolidated Railway to place new equipment in the old steam power station on Chestnut Street in this city so as to make the local plant independent of the power from the Bull's Bridge plant. The plant will be equipped with a 400-kw, 2300-volt, 60-cycle, three-phase generator, with switchboard and panel. The new machinery will be used for lighting and power purposes, and the electric railway system will continue to be operated from the Bull's Bridge plant at New Milford.

WASHINGTON, D. C.—Bids will be received until July 30 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing naval supplies at the various navy yards, etc., as follows: Portsmouth, N. H., schedule 116—electrical wire, etc. New York, N. Y., schedule 103—electrical conduit, wire and supplies, electric lampposts, etc. Washington, D. C., schedule 99—electrical cable, etc. Charleston, S. C., schedule 104—motor drive outfits. Pensacola, Fla., schedule 97—electrical supplies, vulcanized rubber, etc. Mare Island, Cal., and naval training station, San Francisco, Cal., schedule 89—electrical wire, rubber sockets, etc. Puget Sound, Wash., schedule 88—submarine telegraph cable. Schedule 87—annunciators, etc. E. B. Rogers, paymaster general, U. S. A.

JACKSONVILLE, FLA.—The old buoy tender steamer *Wistaria*, in the port of Jacksonville, will soon be equipped with an electric plant, which will provide independent light and fan service. The Hazlehurst Electric Company, of Charleston, has been awarded the contract to install the plant.

ALBANY, GA.—A new water wheel has been received by the Albany Power & Manufacturing Company, and will be installed in its plant located on Muckafoonee Creek, just above the city. A new generator will also be installed, which will double the capacity of the present plant.

DOUGLAS, GA.—Extensive additions and improvements will be made in the municipal electric light plant, and the following new equipment installed: One 200-kw, 2200-volt, two-phase alternator; one 250-hp Corliss or 4-valve engine; one 100-hp Cole boiler; one 12½-kw, 125-volt, direct-current generator; a 12-inch artesian well and an Ingersoll-Rand air compressor. Extensive line improvements will be made, and a day service will be established about Sept. 1. L. M. Alford is manager.

FITZGERALD, GA.—A syndicate of local and foreign capitalists has made application to the City Council for a franchise to operate a street railway in Fitzgerald and to nearby towns. The proposed line will be extended to Ocilla.

TICTON, GA.—A franchise has been granted by the City Council to L. P. Thurman, I. W. Myers, W. W. Banks, O. Daniel, J. E. Cochran and others to construct and operate an electric railway through the principal streets of the city.

BLOOMINGTON, ILL.—Harry E. Rhoades, city clerk, writes that contracts for constructing an electric light plant have been awarded as follows: Engines to the Buckeye Engine Company, Salem, Ohio; generators to the Western Electric Company, Chicago, Ill., and lamps to the Fort Wayne Electric Company, of Fort Wayne, Ind.

CHICAGO, ILL.—The Northwestern Elevated Railroad and the Chicago, Milwaukee & St. Paul Railroad companies are reported to be preparing to accept the ordinances of the city of Chicago and the city of Evanston, authorizing the companies to join their roads at the terminal of the Northwestern elevated by a gradual incline, and to electrify the road between Chicago and Evanston. It is planned to substitute at an early date for the St. Paul suburban steam railroad an improved service on the Evanston division of the electrified road, to be operated jointly by both companies.

ELGIN, ILL.—The trustees of the Illinois Hospital are considering improvements to the hospital, which include the enlargement and improvement of the present power plant, a more adequate water system, etc.

EVANSTON, ILL.—The Evanston Council has granted the Chicago Consolidated Traction Company a franchise to extend its line in North Evanston.

FLORA, ILL.—The managers of the municipal electric lighting plant are contemplating installing a 35-hp producer gas plant next year to furnish a day service for fans, etc. William Parton is manager.

HEYWORTH, ILL.—Charles J. Crump has secured a franchise for an electric lighting, heating and power plant.

JOLIET, ILL.—The contract for the construction of the hydraulic development of the Economy Light & Power Company, of Joliet, on the Des Plaines River, nine miles from Morris, Ill., has been awarded to James O. Heyworth, Chicago, Ill.

KANKAKEE, ILL.—The Kankakee Electric Light Company is contemplating changing its present arc lighting system to alternating-current series arcs. A. S. Maltman is manager.

MT. CARROLL, ILL.—The Mt. Carroll Electric Light Company is contemplating the erection of new pole lines and may possibly erect a small water power plant. J. W. Webb is manager.

PANA, ILL.—The Pana Gas & Electric Company is planning to increase the capacity of its plant and will install a new generator and replace an engine and generator with a direct connected set. H. D. Larabee is manager.

VANDALIA, ILL.—Plans are being considered for increasing the capacity of the municipal electric lighting plant. A new dynamo, exciter and engine will be installed. R. M. Clark is manager.

WESTERN SPRINGS, ILL.—The citizens are contemplating installing two new boilers in the municipal electric lighting plant. Albert Erickson is manager.

DECKER, IND.—Eugene Rush, president of the Hydro-Electric Company, which proposes to erect a dam on White River at this place and establish a hydraulic plant for the manufacture of electricity for light, heat and power, announces that the project has been financed by the Metropolitan Trust & Savings Bank, of Chicago, Ill., which will act as trustee, and that actual work of constructing a plant will begin soon. The company will furnish electricity to towns and cities within a radius of 25 miles.

FORT WAYNE, IND.—We are informed that the City Council on July 16 duly ratified the contracts for the municipal electric light plant, bids for which were opened on June 24, and awarded on June 26, and executed by the Board of Works on June 28. The contracts as awarded and ratified and which were published in the issue of the Electrical World of July 13 are as follows: To Fort Wayne Electric Works, Fort Wayne, for section 3, steam turbine generators and exciters; section 4, condenser equipment; section 7, arc-lamp transformers, switchboard, appliances and station electric works; section 8, arc lamps, and section 10, transformers and connecting public buildings, for a total of $73,899. To McBride Electric Company, of St. Paul, Minn., for section 9, pole line and wiring system and underground (distributing system), and section 11, power plant and coal storage, for a total of $56,002. To the O. K. Engineering Company, of St. Louis, Mo., section 1, boilers and equipments and stack connections, and section 5, feedwater heater, boiler, feed pumps, separators, pipe work and connections, for a total of $19,220. To Alphons Custodis Chimney Construction Company, of Chicago, Ill., for section 2, stack, for $4,400, and to the Moellering Construction Company, of Fort Wayne, section 12, dam in Spy Run, for $1,238. Total contract price, $154,759. Owen Ford, of St. Louis, Mo., is the consulting and supervising engineer.

INDIANAPOLIS, IND.—Frank M. Fauvre, capitalist and promoter of this city, announces that he is organizing a million-dollar company, to construct, equip and operate a large power plant near Seeleyville, east of Terre Haute, to manufacture electricity for transmission to Indianapolis and other cities. Distribution of the electricity in Indianapolis and other cities will be effected through the company's plants already in operation, but its scope will be greatly enlarged when the new plant is put in operation.

SOUTH BEND, IND.—Articles of incorporation and agreement have been filed for the merging of the St. Joseph & Elkhart Power Company, the Elkhart Electric Company and the South Bend Electric Company. The new company will be known as the Indiana & Michigan Electric Company. The capital stock is $1,915,500. The corporation has two dams in the St. Joseph River and will build another at Bristol, Ind. Electricity will be furnished in South Bend, Mishawaka, Elkhart, Goshen, Laporte, Niles, Buchanan, Bristol and other towns. H. K. and H. C. Chapin, C. B. Calvert, M. L. Newell and R. Talbot are the directors.

CARROLL, IA.—Judge McPherson's decision in the controversy over the Carroll Light, Heat & Power Company was made public July 14. The court orders the debts of the company, including the expenses of the receivership, to be paid within ten days, and orders that in default of this being done the plant shall be sold at auction. A condition of the sale is that no bid of less than $50,000 shall be considered, each bidder being requested to deposit $25,000 in cash. No appraisement or valuation is to be made prior to the sale, the court reciting that the plant must be sold as a whole and not dismembered.

FORT DODGE, IA.—The City Council has instructed the city attorney to begin ouster proceedings against the Fort Dodge Light & Power Company for alleged violation of its franchise. The Council a short time ago notified the company that its charges were illegal, but the company paid no attention to the notice. The case will be tried in the January term of court.

MT. AYR, IA.—A. Bartenlanger, of Omaha, Neb., has secured the contract for constructing an electric light plant in this place for $17,626.

COVINGTON, KY.—The City Council has passed a resolution authorizing the committee on light to have 50 arc lamps placed in Central Covington.

LOUISVILLE, KY.—A meeting of the board of directors of the Cumberland Telephone & Telegraph Company has been called for Aug. 6, at which time the question of increasing the capital stock of the company from $20,000,000 to $20,200,000 will be voted on. The company is also contemplating changing its headquarters from Hopkinsville to Louisville.

MAYFIELD, KY.—J. W. Williams, representing J. W. Williams & Company, has purchased the street railway franchise which was sold by the Mayor, July 12, for $200.

BANGOR, ME.—The water power development in Aroostook County, known as the Brunswick Electric Power Company, projected and financed by Arthur Gould, of Presque Isle, is practically finished. Contracts for power have been let amounting to $36,000 a year, which absorb only about one-quarter of the power generated. The new company will supply a large territory with electricity, besides furnishing water to several towns.

WATERVILLE, ME.—The Eaton and Wyman water power privilege on the Sebasticook River, near Fort Hill Cemetery in Winslow, has been purchased by the management of the Augusta & Waterville Electric Railway Company, and the contract for the erection of a large plant will soon be awarded. The cost of the dam and power house is estimated at $130,000 and is to be completed before Nov. 1.

WATERVILLE, ME.—The Lewiston, Augusta & Waterville Street Railway has recently completed an arrangement with the Fort Halifax Power Company for a supply of electricity for a term of 30 years. The power company will furnish electrical power for all the lines and extensions between Waterville and Sabattus. The Fort Halifax Power Company has acquired land and water rights along the Sebasticook in Winslow, and a dam and power station will be constructed a short distance above the highway bridge in that village.

BALTIMORE, MD.—Victor G. Bloede, president of the Patapsco Electric & Manufacturing Company, has announced that he is ready to submit satisfactory evidence of the ability of his company to supply the city with electricity to light the courthouse and city hall at a figure much lower than that quoted by any concern now doing business in the city. The company is now operating in the city on a private right of way on Frederick Avenue as far as Bentalou Street and desires to secure a franchise to use the city's conduits for its wires in the city. The Patapsco Electric & Manufacturing Company has recently completed a large plant at Ilchester, which, with its large plant at Gray's Mills, gives the company a capacity of 25,000 horse-power. The company now furnishes electricity for lighting in Catonsville and Ellicott City, and a large part of both Baltimore and Howard counties. The Gray's Mills plant has been in operation about seven years.

CHARLTON CITY, MASS.—Three new transformers are being placed in the Charlton City power station to replace the ones now in use.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company is planning to erect its pole line to Turners Falls, to take additional power from the plant of the Turners Falls Company before cold weather, in case the supply from Gardiner Falls should fail.

GROVELAND, MASS.—The electric light commission has secured plans and specifications for the proposed power house and will soon be ready to proceed with the erection of the plant. The plant will be erected on land owned by the town.

LYNN, MASS.—Work has commenced on the construction of the addition to the power house of the Lynn Gas & Electric Company. The cost of the building is estimated at $50,000.

NORTHAMPTON, MASS.—The Northampton Electric Lighting Company is installing 4500 new lamps in Florence.

PETERSHAM, MASS.—John A. Carter, C. H. Eddy and E. C. Dexter, of Petersham, are interested in a project to furnish electricity for lighting the towns of Petersham, Barre and Dana. Power will be furnished from the Swift River, and surveys above the proposed location in Webb village are being made, and all options on the property along the river have been secured.

WEST SPRINGFIELD, MASS.—Owing to not being able to secure sufficient power from the United Electric Company, the United Drop Forge Company has decided to install a power plant of its own. A new power house has been erected in which will be placed boilers and two engines having a capacity of 300 horse-power.

DETROIT, MICH.—Mayor Thompson has decided to request H. H. Crowell, electrical expert, of Syracuse, N. Y., to examine into conditions in connection with the public lighting commission, mainly to see what new machinery it is advisable to obtain to enable the commission to produce electricity at a more economical figure, if possible.

MANISTEE, MICH.—The Manistee Traction Company and the Northwestern Michigan Light & Power Company have been consolidated under the name of the Manistee Light & Traction Company.

ST. JOSEPH, MICH.—Representatives of Charles A. Chapin, of Chicago, Ill., have announced plans for the construction of three additional power dams on the St. Joseph River, to cost $5,000,000. The company now has in operation or in course of construction on the river five power plants. The new properties will give them eight stations, with an aggregate investment of $10,000,000.

WYANDOTTE, MICH.—A special election will be held July 29 to vote on the proposition of issuing $20,000 in bonds for extensions and improvements to the electric light plant.

DAWSON, MINN.—Plans are being prepared by Oscar Claussen, of St. Paul, for an electric light plant and water works system, to cost about $28,000.

MINNEAPOLIS, MINN.—The Minneapolis Heating & Transmission Company has petitioned the City Council for a 25-year franchise to tunnel the streets of the city for conduits in which to transmit electricity for light and heat.

MINNEAPOLIS, MINN.—Plans are being made by the Minneapolis,

Kansas City & Gulf Railway Company to build a double track railway, to be operated by electricity, from Minneapolis to the Gulf. C. D. Holmes, G. A. Barnett and others are interested in the project.

ROCHESTER, MINN.—Engineer Charles L. Pillsbury, of St. Paul, has completed his report on the requirements of the municipal electric light plant and recommends rebuilding the entire plant.

HATTIESBURG, MISS.—The Hattiesburg Light & Power Company, the Hattiesburg Traction Company and the Hattiesburg Gas Company have been merged into one company, and the corporation will retain the name of the Hattiesburg Traction Company. The combined capital is $300,000 and will be increased at once to $500,000. Extensive improvements will be made to the electric and gas plants, and it is expected to have five miles of the street railway in operation within sixty days.

WATER VALLEY, MISS.—The purchase of a 300-hp water-tube boiler for the municipal electric light and water plant is now under consideration. T. M. Early is manager.

CARTHAGE, MO.—The Carthage Electric Light & Power Company is making extensive improvements and extensions to its plant. A new water wheel has been installed at the Belfort power house, and a generator and three transformers are being placed in position. Preparations are being made for the installation of two new transformers at the sub-station on Belfort Street, which may necessitate an addition to the building. A new switchboard will also be installed. When the work is completed the capacity of the plant will be nearly doubled, but for the present will be used mostly as an auxiliary to the present system. At the annual meeting held recently the following named officers were elected: John E. Strickland, president and manager; C. M. Rohr, vice-president; S. M. Strickland, secretary and treasurer, and Frank M. Galloway, general superintendent.

HOLDEN, MO.—Bids will be received until July 31 by O. G. Boissea Mayor, for $6,000 in bonds, the proceeds to be used to enlarge and extend the electric light plant.

FREMONT, NEB.—J. W. Andrews, city engineer, writes that plans have not yet been completed for the proposed municipal water and light station, which will cost about $60,000. Contracts for engines and dynamos have been let. Charles A. Chapman, 204 Dearborn Street, Chicago, Ill., is consulting engineer.

TECUMSEH, NEB.—The citizens voted to issue $16,000 in bonds for an electric light plant.

TECUMSEH, NEB.—Frank L. Dinsmore writes that John Martz, of Seward, is preparing plans for the proposed electric light plant, to cost about $20,000.

RENO, NEV.—Major J. A. Driffil, of Oakland, president of the Ely Electric Company, and Carl Lennhart, of Los Angeles, state that the company will begin immediately the construction of a 1000-hp electric plant and a large reservoir in this city. Cave Creek will supply the water for the reservoir.

MANCHESTER, N. H.—The Amoskeag Manufacturing Company is contemplating a number of improvements to its plant, and may install a central electric lighting plant.

MADISON, N. J.—S. G. Willets, borough clerk, writes that the light committee has under consideration the question of doubling the capacity of the municipal electric light plant, and may recommend the matter to the Borough Council at the August meeting. Nothing definite has yet been done.

MORRISTOWN, N. J.—The Morris & Somerset Electric Company, which has recently secured the contract for street lighting, is making preparations to commence work on the construction of its plant. The company also has an ordinance before the Aldermen granting it a franchise to furnish electricity to private consumers.

NEWARK, N. J.—The Common Council on July 12 appropriated $30,000 for the installation of an electric light plant in the City Hall, and also decided to have the people vote next November on the proposition of building a municipal electric plant for lighting the streets at a cost of $1,000,000. Both resolutions have been signed by the Mayor. The new contract with the Public Service Corporation will run until September, 1912.

ROSWELL, N. M.—The Roswell Electric Light Company will soon make extensive additions and improvements to its plant. Preparations are being made to install the new equipment, which consists of a 250-hp engine, and a 300-kw, 3-phase, General Electric generator. Luther Stover is manager.

BATH, N. Y.—The Board of Village Trustees has abandoned the idea of municipal ownership of the street lighting plant, and has completed a contract to be entered into by the Bath Electric Light Company with the village, upon the expiration of the present lighting contract in September. The contract calls for 75 arc lamps and for 10 incandescent lamps of 25 cp. together with two lamps at the fire companies' building, at a cost of $5,000 per year. Under the old contract the maximum price for electricity for commercial lighting was 18 cents per kw-hour, whereas under the new contract it is reduced to 15 cents. In accepting the new contract the company agrees to install a duplicate set of machinery in the power plant, and to replace the old arc lamps now in use with new and improved lamps. A bond of $3,000 will be given for fulfillment of the contract.

BUFFALO, N. Y.—The Buffalo & Lake Erie Railway Company has made a contract with the Ontario Power Company for 500 horse-power. Rapid progress is being made on the line from Erie to Buffalo, and the company hopes to have the road in operation before the end of the year.

CANAJOHARIE, N. Y.—The Montgomery Electric Light & Power Company and the East Creek Electric Light & Power Company are making arrangements to build a new sub-station on West Main Street. As soon as the building is completed the old sub-station will be abandoned. A. B. Cairns is superintendent.

DUNKIRK, N. Y.—The Water Commissioners have awarded the contract for a 500-kw turbo-generator set for the electric light plant and the water works system to the Allis-Chalmers Company, of Milwaukee, Wis., for $19,500.

GOUVERNEUR, N. Y.—The Hannawa Falls Electric Power Company has its transmission line completed to this village, and will soon commence work within the corporation limits. The distributing station will probably be built on the Porter road near the village. The company was granted a franchise last fall. It is understood that the company has placed contracts for furnishing electricity with several manufacturing companies in this village.

NEW YORK, N. Y.—Bids will be received until Aug. 5 (readvertisement) by Robert W. Hebberd, Commissioner Public Charities, New York City, for all materials and labor required for the complete conduiting, electric wiring and all other work in connection with the installation of a complete electric lighting and power system for all the buildings and grounds under the jurisdiction of the Department of Public Charities, and comprising the Metropolitan Hospital District, Blackwell's Island, Borough of Manhattan.

RANDLEMAN, N. C.—The Randleman Electric Railway Company has been granted a franchise to erect an electric power plant to furnish electricity for lighting and power purposes in the city. Work will commence at once on the construction of the plant.

MIDDLETOWN, OHIO.—The Independent Telephone Company has been granted a franchise for a term of 25 years to construct and operate a telephone system in this city. The company will place its wires underground in the business section of the city.

TOLEDO, OHIO.—At the request of Receivers Willis Baldwin, of Monroe, Mich., and I. H. Bergoon, of Fremont, Ohio, the court has ordered the immediate sale of the Toledo, Ann Arbor & Detroit Electric Railway property, which consists of a right of way from the Ohio State line to Ann Arbor, a distance of 45 miles, 21 miles of track laid and a power house at Petersburg, Mich. The property is valued at about $250,000 and will be sold on a cash basis.

COQUILLE, ORE.—The Coquille River Electric Company will soon install a 150-kw, 3-phase, 2300-volt General Electric alternator in its plant. Frank Morse is owner and manager.

LEBANON, PA.—Bids will be received until Aug. 31 by the Police Committee (George D. Krause, chairman) for street lighting. Bids are to be submitted on two propositions and are to be for lighting every night and all night for a term of one and five years as follows: For 150 or more enclosed arc lamps of 2000 cp each; 150 or more series incandescent lamps of 24 cp each.

READING, PA.—The Ridgway Dynamo & Engine Company, of Ridgway, Pa., has secured the contract for engines for the municipal electric lighting plant and the Western Electric Company, of New York, N. Y., for the generators. The work is in charge of R. D. Kimball, of Boston, engineer.

SCRANTON, PA.—The plant of the Economy Light, Heat & Power Company has been sold to the American Gas & Electric Company. The new company will take control in September.

WAYNESBURG, PA.—The Waynesburg & Monongahela Street Railway Company has made application to the Borough Council for a franchise to operate its line in this borough. The company proposes to reach the river by the way of Jefferson, Clarksville and Millsboro.

WAYNESBURG, PA.—W. J. Sheldon, of McKeesport, president of the McKeesport, Carmichaels & Brownsville Street Railway Company, has applied to the Borough Council for two franchises, one for operating an electric railway on different streets of the borough, and the other for the establishment of an electric light and power plant.

WILKES-BARRE, PA.—The Wilkes-Barre Heat, Light & Motor Company has decided to erect a sub-station on South Main Street, near Sullivan Street. It is the intention of the company to supply the residents of the lower section of the city with steam heat.

PROVIDENCE, R. I.—The installation of a new electric lighting and heating plant at the Rhode Island College is under consideration, and a committee consisting of C. D. Kimball and Robert S. Burlingame has been appointed to investigate the matter. The power station, if required, will be erected in the rear of Lippitt Hall. The cost is estimated at $7,000.

ABERDEEN, S. D.—The City Council has adopted a report which recommends the passing of an ordinance which will permit the granting of a franchise for an electric lighting and power plant. The city has already voted $35,000 in bonds for an electric light plant, but as this amount is insufficient and there is no legal way to raise more money, it is thought advisable to grant a franchise for a private plant.

MITCHELL, S. D.—John Absher, of Wagner, president of the Wagner, Lake Shore & Armour Traction Company, writes that the company is now constructing light and power plants at Armour and Platte, S. D., and expects to commence work at Mitchell about Sept. 1. The company

is now operating a plant in Wagner, and will soon commence the construction of a suburban line from Wagner to Mitchell. The power plants now under construction will supply electricity for operating the electric railway as well as to light the different municipalities. The company will soon be in the market for machinery, rails and ties.

BIG SPRING, TEX.—The local electric lighting plant owned by L. L. Stephenson was recently destroyed by fire, causing a loss of $10,000.

BONHAM, TEX.—The Texas Telephone Company has sold its entire plant and system to R. R. Durrett and others, of Hopkinsville, Ky., for $27,800.

FLORENCE, TEX.—The construction of an electric lighting plant in this place is now under consideration. A. W. Strange is interested in the project.

GALVESTON, TEX.—Amendments have been filed to the charter of the Martin Telephone Company, of Llano County, increasing the capital stock from $20,000 to $40,000.

HUBBARD CITY, TEX.—The Union Central Light & Ice Company is planning to increase the capacity of its plant to furnish electricity in the neighboring towns. The company has issued $25,000 in bonds, and wishes to make arrangements with a construction company or engineer to build the addition to the plant, taking the bonds at 85 per cent in payment for the work.

TOYAH, TEX.—The Toyah Electric Light Company, recently organized, has placed contracts for the construction of its electric light plant.

MONTPELIER, VT.—At the annual meeting of the Barre & Montpelier Traction & Power Company held recently the company was reorganized and the new owners placed in control. The company is planning extensive developments, and F. M. Cory, I. M. Frost and E. H. Deavitt have acquired water rights on the Winooski River for the purpose of installing a power plant to furnish electricity for operating the road. About 2000 horse-power can be developed on the property. The cost of the plant is estimated at $150,000. The directors have elected the following officers: F. M. Cory, president; H. K. Bush, vice-president; E. H. Deavitt, clerk and treasurer; I. M. Frost, general manager, and F. H. Andrus, superintendent.

CHEWLAH, WASH.—Bids will be received until Aug. 1 for constructing an electric light plant and water works system. F. C. Ranch is town clerk.

KAHLOTUS, WASH.—The Kahlotus-Washtucna Telephone Company has made application to the Town Council for a 25-year franchise to construct a telephone system in the town.

SUNNYSIDE, WASH.—T. A. Noble, of North Yakima, has made application for a franchise for an electric light plant and water works system in this place.

CHIPPEWA FALLS, WIS.—The Chippewa Valley Telephone Company has filed amendments to its charter, increasing its capital stock from $10,000 to $25,000.

EAU CLAIRE, WIS.—We are informed that the Chippewa Valley Electric Railroad Company is planning to purchase a 125 to 250-kw, 600-volt, direct-current generator and two new interurban cars. G. B. Wheeler is general manager.

LADYSMITH, WIS.—H. J. C. Young has secured permission to construct a dam on Jump River.

LADYSMITH, WIS.—The John Hein Company is reported to have decided to erect a power plant and develop 12,000 horse-power at Big Falls, 10 miles north on Flambeau River.

MARINETTE, WIS.—Perley Lowe, of Chicago, Ill., is contemplating the development of Peshtigo River at Places Rapids, and transmitting power to Marinette.

WAUSAU, WIS.—At the annual meeting of the Wisconsin Valley Improvement Association held recently it was decided to purchase under its options all the existing reservoirs along the Wisconsin River, and to push the investigation of possible reservoir sites for the purpose of enlarging the system; also to engage a general manager and to open a central office in Wausau. The directors elected the following officers: George A. Whiting, president; Walter Alexander, vice-president; G. D. Jones, secretary and treasurer.

WINNIPEG, MAN.—The City Council has granted permission to the Winnipeg Electric Company to proceed with the construction of ten additional street car lines. Address Wilford Phillips, general superintendent.

OTTAWA, ONT.—The Civic Electric Commission has ordered a 750-hp generator to be installed at the city water works as a temporary source of supply to the municipal electric plant. Arrangements have been made by the Hydro-Electric Power Commission and the Hull & Ottawa Power Company, whereby the company is to furnish electricity for operating the municipal electric plant. As a result of the conference the power company made important concessions to the city, and it is expected these will be accepted by the City Council.

TORONTO, ONT.—Work has commenced in connection with the establishment of a municipal electric light plant in this city. Cecil B. Smith, of Detroit, Mich., is consulting engineer.

MOOSEJAW, SASK.—A petition is being circulated among the ratepayers in favor of raising $90,000 for extensions to the electric lighting plant. Address J. H. Bunnell.

GUADALAJARA, MEX.—Manuel Cuesta Gallardo, of this city, is organizing a company to install a great hydro-electric plant on the Santiago River. Mr. Gallardo owns the water and power rights on the Santiago River for a distance of 25 miles, and also owns a concession granted to him by the Federal Government for the use of the waters of Lake Chapala for irrigation purposes and for reclaiming land around the lake. A transmission line will be built to Lake Chapala and a portion of the power used to operate the large irrigation pumps that will be installed there. Other transmission lines will be built to Guadalajara and nearby towns and industrial plants.

MEXICO CITY, MEX.—L. O. Harnecker, of Mexico City, is arranging to install a hydro-electric plant near Union de Tula, State of Jalisco. The water of the Ayutla River will be used.

MEXICO CITY, MEX.—A hydro-electric plant is to be installed on the Rio Atoyac, in the State of Puebla, by Luis Gomez Daza, of Mexico City. The falls in that river between the bridge of Tzicatlacoyan and the Hacienda de Coattingo will be utilized to afford the initial power for the plant.

QUERETANA, MEX.—The Compania Hydro-Electrica Queretana, of this city, has entered into a contract with the Ajuchitlan Mining Company to furnish it with electrical power to operate its mines. The mining company is installing electric motors and electrical equipment in the mines. The transmission line to the mine is about 20 miles long.

SALTILLO, MEX.—The Fuerza Electrica Mexicana, S. A., of Saltillo, has obtained the rights to a concession which was previously granted by the Federal Government to G. A. Lilliendahl, of that place, to use the waters of the Pilon River for power purposes and to install a hydro-electric plant. It is stated that the work of constructing the plant will soon commence.

Company Elections.

TURNERS FALLS, MASS.—At the annual meeting of the Franklin Electric Light Company, held July 16, the following named officers were elected: J. F. Bartlett, president; E. I. Cassidy, clerk, and W. C. D. Thomas, treasurer. The company is now at work upon a scale of prices for electricity for lighting purposes and is in hopes to have the same in effect by the first of September or October.

New Industrial Companies.

THE AURORA ELECTRIC COMPANY, of Aurora, Ind., has been incorporated to establish and equip a plant to manufacture electrical apparatus and supplies of all kinds. Charles F. Mayer, H. P. Spaeth and D. J. Hauss are the directors.

THE LINOLITE COMPANY OF AMERICA has been organized at Portland, Maine, for the purpose of manufacturing and dealing in electric lamps, etc. The company has a capital stock of $300,000, and the officers are: William Sturgis, of Scranton, Pa., and Ray Phelps, of New York, N. Y., treasurer.

New Incorporations.

SAN JOSE, CAL.—Articles of incorporation have been filed for the Donnels Flat Water & Power Company. The company is capitalized at $1,000,000, and the directors are William Bogen and L. E. Hanchett, of San José; F. J. Koster, W. H. Metson and L. W. Smith, of San Francisco. The company has been formed for the purpose of securing and holding water rights, and the construction and maintenance of electric railways and light and power plants.

ATLANTA, GA.—The Tennessee & Georgia Interurban Railway Company has been granted a charter by the Secretary of State to build an electric railway from Rossville through Chickamauga Park to Ringgold and Catoosa Springs, a distance of about 25 miles. The capital stock of the company is $500,000 and the incorporators are: James C. Bryan, James L. Jones, W. E. Biggers, J. T. Robinson, J. W. Clark, W. E. Mann and M. W. Murphy, Catoosa County; S. W. Divine, Walker County, and W. H. Paine, Jr., of Chattanooga.

GREENFIELD, ILL.—The Greenfield Electric Light & Power Company has been organized with a capital stock of $7,500 by J. T. Callaway and others.

HIGHLAND, ILL.—The Madison County Interurban Belt Railway Company has been incorporated with a nominal stock of $25,000. The incorporators and the first board of directors are: W. P. Wall, John Bardilla, John Gehrig, John Wildi and J. L. Rhein.

LINCOLN, ILL.—Articles of incorporation have been filed for the Mt. Pulaski Independent Telephone Company, with a capital stock of $8,500, by W. E. Birks, J. M. Buckles, George T. Lucas and others.

GARY, IND.—The Gary Street & Interurban Railway Company has filed articles of incorporation, with $400,000 capital stock, for the purpose of building and operating street and interurban railroads in and connecting Gary, Tolleston, Hammond, East Chicago and Whiting. Frank N. Gavitt, C. B. Manbeek and M. N. Casleman are the directors.

PORTLAND, ME.—The Portland, Gray & Lewiston Railroad Company has been incorporated with a capital stock of $150,000 to construct an electric railway through the towns of Falmouth, Gray and New Glouces-

ter, and thence to Auburn and Lewiston. The incorporators are: Edward W. Gross, of Auburn; Charles C. Benson, of Lewiston; Lewis A. Goudy, of Portland; John D. Clifford. of Lewiston, and others.

BELGRADE, MO.—The Belgrade Telephone Company has been incorporated, with a capital stock of $1,500, by J. A. Easton and others.

BANTRY, N. D.—The Bantry Telephone Company has been incorporated, with a capital stock of $10,000, by James McIntyre and others.

FORBES, N. D.—The Forbes Rural Telephone Company has been incorporated with a capital stock of $10,000 by O. K. Schuls and others.

GLENBURN, N. D.—The Lone Star Rural Telephone Company has been incorporated, with a capital stock of $10,000, by A. Walton and others.

GRAND HARBOR, N. D.—The Grand Harbor Telephone Company has been chartered, with a capital stock of $5,000, by Simon Kingslie and others.

LISBON, N. D.—The Farmers' Southwestern Telephone Company has been chartered, with a capital stock of $10,000, by Erik Sovdo and others.

CLEVELAND, OHIO.—The Elyria Southern Railway Company has been incorporated, with a capital stock of $100,000, by W. J. Elliott, F. N. Carpenter, W. E. Moser, J. M. Storr and F. L. Sargent. The company proposes to build an electric railway between Elyria and West Salem.

QUAKER CITY, OHIO.—The Farmers' Telephone Company has been incorporated, with a capital stock of $5,000, by W. W. James and others.

UNION FURNACE, OHIO.—The New Plymouth Telephone Company has been incorporated with a capital stock of $1,000 by W. P. Miller, W. A. Horner, C. W. McClain, F. M. Ludlow and R. B. Longstreth.

CESTOS, OKLA.—The Independent Telephone Company has been incorporated with a capital stock of $25,000 by H. A. Seaton, J. W. Kerns and F. C. Hoyt.

ENID, OKLA.—The Enid, Waukomis & Oklahoma City Interurban Railway Company has been chartered for the purpose of building an electric railway 100 miles in length. R. W. Brittan, of Waukomis, is president of the company.

EL RENO, OKLA.—The Midland Telephone Company has been chartered with a capital stock of $2,500 by Elmer N. King and others.

GEARY, OKLA.—The Maple Telephone Company has been incorporated, with a capital stock of $600, by Byron Baker, A. C. Gilmore and S. S. Schmoyer.

KELL, OKLA.—The Kell Telephone Company has been incorporated with a capital stock of $5,000 by P. S. Seamans, F. J. Hansen and J. Hansen.

TRIBBY, OKLA.—The Tribby-Mardock Farmers' Union Telephone Company has been incorporated, with a capital stock of $5,000, by F. M. White and others.

FOREST GROVE, ORE.—The Haines Electric Power Company is planning to develop its water power of 500 ft. head, and installing more machinery in its power house. E. W. Haines is manager.

PITTSBURG, PA.—Articles of incorporation have been filed for the Anglo-American Light Company by Jacob Veiger, Charles Veiger, of Pittsburg, Pa.; Q. A. Stevens, of Bellevue, Pa. The company is capitalized at $100,000, and it proposes to furnish light, heat and power for commercial and manufacturing purposes.

COLLIERVILLE, TENN.—The Collierville Telephone Company has been incorporated, with a capital stock of $5,000, by Samuel Hinton and others.

MORRISTOWN, TENN.—The Home Telephone Company, of this city, has been incorporated with a capital stock of $40,000 by A. W. Letspeich, Baldwin Harle, W. W. Hobby, and others.

NASHVILLE, TENN.—The Colby Telephone Company has been incorporated, with a capital stock of $1,500, by J. L. Mackey and others.

GRAND SALINE, TEX.—The Farmers' Mutual Independent Telephone Company has been incorporated with a capital stock of $5,000 by M. E. Davis and others.

HOUSTON, TEX.—The Houston Telephone Company has been granted a charter by the Secretary of State with a capital stock of $100,000. The incorporators are J. D. Slusher and others.

TEMPLE, TEX.—The Rogers Water & Light Company has been incorporated with a capital stock of $50,000 by John J. Cox, R. L. Brown and others.

WACO, TEX.—The Consumers' Power & Light Company has been incorporated, with a capital stock of $150,000, by Joseph Henry and others.

WINNSBORO, TEX.—The Winnsboro Telephone Company has been incorporated with a capital stock of $15,000 by W. D. Weir, R. L. Weir and C. B. Weir.

RANDOLPH, UTAH.—The Utah & Wyoming Telephone Company has been incorporated, with a capital stock of $10,000. The company will soon install a system to connect Randolph, Woodruff, Laketown and Evanston. Wesley K. Walton is president, and George Spencer is managing director.

SALT LAKE CITY, UTAH.—Articles of incorporation have been filed with the Secretary of State for the Vernal Milling & Light Company with a capital stock of $50,000. S. R. Bennion is president.

TUMWATER, WASH.—Articles of incorporation have been filed for the Tumwater Light & Power Company with the Secretary of State with a capital stock of $50,000. The company is now building an electric plant and will acquire the light and water franchises already secured from the City Council by Leopold Schmidt, and supply electricity for lighting and power in the city, and also for the brewing plant. The incorporators are: Leopold Schmidt, Peter G. Schmidt, Josey R. Speckart, Frank M. Kenney and Edmund Rice.

PLYMOUTH, W. VA.—The Athens Telephone Company has been incorporated, with a capital stock of $5,000, by W. J. Ganter and others.

CLEAR LAKE, WIS.—The Clear Lake Telephone Company has been incorporated, with a capital stock of $5,000, by J. C. Saxon and J. S. Griffin.

COLUMBUS, WIS.—The Watertown Telephone Company has been organized, with a capital stock of $15,000, by Oscar Wertheimer and others.

MADISON, WIS.—The Badger Hydro-Electric Company has filed articles of incorporation with the Secretary of State for the purpose of constructing and operating dams and power plants in Wisconsin and to generate, distribute and sell electricity. The company is capitalized at $1,000,000, and the incorporators are Magmer Swenson, E. B. J. Schubring and Frank H. Hanson.

OAKLAND, WIS.—The West Oakland Telephone Company has been incorporated with a capital stock of $350 by M. C. Kravik, Andrew F. Olsen and G. C. Larson.

WATERTOWN, WIS.—The Watertown Telephone Company has been organized with a capital stock of $15,000 by Oscar C. Wertheimer, J. F. Prentiss and W. H. Woodard.

Legal.

TELEPHONE SERVICE.—At Helena, Mont., in the United States Court, Judge W. H. Hunt has rendered a decision of importance to telephone users. He held that one company could not withhold the use of its lines from another, even though it be competing. The Montana and Wyoming and the Mutual Telephone companies applied to the court for an order compelling the Rocky Mountain Bell Telephone Company to furnish connections, when desired, at reasonable compensation. This was resisted on the ground that the lines were built for its patrons and not for those of competing companies. Extended arguments were made. Judge Hunt found for the complainants, and stated that within a few days he would name a commission to fix the division of charges when such use is made of connecting lines.

EMPLOYERS' LIABILITY.—Judge Adams, in the United States Court, has handed down a decision declaring constitutional the employers' liability law, passed by Congress one year ago, which makes employers responsible for damages in cases of injury to workmen sustained through the negligence of fellow employees. This is the first decision on the statute in New York State, and was rendered in the case of Patrick Lancer, who was injured while at work on the steamship *Columbia* through a skid which he alleged was improperly placed. A similar statute has been upheld in Illinois, but has been declared unconstitutional by Federal judges in Georgia and Kentucky. The law will doubtless eventually go to the United States Supreme Court for settlement.

THE EICKEMEYER PATENT.—In the United States Circuit Court for the Northern District of New York, Judge Ray has handed down an opinion in the case of the General Electric Company vs. Wilbur F. Corliss et al., trading under the name of Corliss, Coon & Company upon Eickemeyer patent No. 677,308, granted June 25, 1901. This suit was brought by the General Electric Company to restrain Corliss, Coon & Company, Cohoes, N. Y., from further infringement of Eickemeyer patent No. 677,308 in the use of some induction motors manufactured by the Allis-Chalmers Company. The feature of these motors which formed the basis of the suit was the relation between the number of slots in the field and the number of slots in the armature whereby all dead points or locking positions are eliminated from the motor. This feature is claimed to be essential to all commercial induction motors of any size. The court holds that the patent is valid and infringed by the defendants.

THE CENTER OF A PUBLIC STREET NOT A PROPER PLACE FOR THE ERECTION OF AN ELECTRIC LIGHTING PLANT.—The municipality of Trenton, Mich., acting through its Council and Board of Water Commissioners, caused to be erected in the center of St. Joseph Avenue a building, 30 by 32 feet, to be used for the installation and erection of an electric lighting plant. This innovation was not approved by the residents of the neighborhood, who claimed to have suffered great inconvenience and annoyance from the large volumes of smoke and soot emitted from the smokestack of the plant, and the noises of a large steam whistle blown each day. An action was brought by one of the sufferers in an attempt to bring about the removal of the obnoxious structure. It was held that the municipality had made an improper use of the street and that the building could not remain. Municipal corporations, notwithstanding their broad and comprehensive powers, have no right, unless authorized by the Legislature, to alienate their streets or devote them to uses inconsistent with the rights of the general public and the abutting land owners. The municipality holds the streets and the power to regulate and control them in trust for the public and cannot put them to any use in-

consistent with street purposes. Thus cities have no right to use their streets for the erection of municipal buildings or works, and it has been held that the placing of a stand pipe in a public street, the fee of which was in the municipality, was an unlawful use of the street. McIllhinny vs. Village of Trenton, Supreme Court of Michigan, 111 N. W. Rep. 1083.

LOWEST BIDDER ON CONTRACT TO FURNISH CITY WITH ELECTRIC LIGHT CANNOT COMPEL CITY TO EXECUTE AGREEMENT.—Where a city has advertised for bids upon a contract to supply electric light and bids have been submitted thereunder the lowest bidder cannot, as a matter of right, compel the city to enter into an agreement with him in accordance with the terms of his bid. This is a recent holding of the Supreme Court of Wisconsin. The charter of the city of Oconto provides that "all work for the city or either ward thereof shall be let by contract to the lowest responsible reasonable bidder." Pursuant to the direction of this provision, the city advertised for bids for furnishing 50 arc lights, more or less, and received responses from two parties. The plaintiff underbid the other competitor, but both bids were rejected and a new advertisement was prepared. This was repeated several times, the plaintiff each time submitting a lower bid than that of the other bidder, until the plaintiff finally instituted action to compel the city to accept its bid. The plaintiff, of course, gained no legal rights upon the submission of the lowest bid, for there could be no contract until the bid was accepted. The plaintiff contended, however, that a clear public duty was imposed by law upon the city to enter into a contract with the lowest bidder. But the court held to the contrary. The taking of bids upon a particular plan may well be merely to acquire information as to feasibility or cost of that plan as a basis for intelligent decision whether that or some other is the more desirable. The Council, having ascertained the price at which they can obtain arc lighting by contract, owes to the public the duty to consider whether some other type of illuminant may not be for the public benefit; also whether the city might not better install its own lighting plant. For these reasons it was held that there was no duty upon the city to enter into a contract with the plaintiff. People's Land & Manufacturing Company vs. Holt, Mayor, etc., 111 N. W. Rep. 1106.

INJURY TO TELEPHONE LINEMAN FROM CONTACT WITH DEFECTIVE ELECTRIC LIGHT WIRE.—The plaintiff, an employee of the New England Telephone & Telegraph Company, was injured as a result of coming in contact with a wire belonging to the defendant, the Gloucester Electric Company. The two companies maintained lines of telegraph poles along the street in Gloucester, Mass., in which the accident occurred. At the time of the injury the plaintiff was ascending one of the telephone company's poles for the purpose of assisting in the stringing of a cable. An electric wire of the lighting company passed within 4 or 5 inches of the pole upon which the plaintiff was at work. The plaintiff testified that, while climbing the pole at a point near the defendant's wire, he felt the pole sway. This was all that he remembered, but it was shown by other witnesses that the insulation of the electric light wire was worn off at the place where it passed the pole in question. The defendant claimed that the liability of electric wires to get out of repair is so well understood by experienced linemen, and the danger is so well within their knowledge, that the lineman should be held to assume the risk of the danger incident thereto, but that the doctrine of assumption of risk is applicable only as between employer and employee and the injured lineman was not in the employ of the defendant company. Another defense was that the plaintiff was guilty of contributory negligence in voluntarily bringing himself in contact with the live wire, without even the safeguard of a safety belt. But the court ruled against the defendant company on this question also. A decision in favor of the plaintiff, however, was reversed on the ground that the trial judge, in his instruction to the jury, made it possible for them to determine upon a verdict with reference to the particular plaintiff and his own situation, and not by the standard of what a man of ordinary prudence would have done under the same circumstances. Gloucester Electric Company vs. Dover, United States Circuit Court of Appeals, 153 Fed. Rep. 139.

Obituary.

MR. H. H. BARNHORN.—We regret to note advices from Cincinnati of the death of Mr. Henry H. Barnhorn, secretary of the Cincinnati Gas & Electric Company. He was a twin brother of Mr. Clement Barnhorn, the well-known sculptor. He was a graduate of St. Francis Xavier College and was connected also at the time of his death with the *Catholic Telegraph*.

MR. R. M. HOAGLAND.—The Minneapolis *Journal* of July 13 says: "R. M. Hoagland, electrical engineer, of the class of '07 at the University of Minnesota, was drowned yesterday at Canyon Ferry, Mont. News of the accident was received by his father, Roger Hoagland, of Minneapolis, last night. Mr. Hoagland left three weeks ago to take a position with the Missouri River Power Company. He was helping to place a flashboard upon the dam when a pulley on the plank on which he was standing threw him into the water. He was swept over the dam and drowned."

Personal.

MR. J. W. WHITE has been appointed superintendent of the Nevada-California Power Company at Goldfield, Nev.

MR. JOHN F. STEVENS, formerly Panama Canal engineer, has been appointed a vice-president of the New Haven Road by President Charles S. Mellen. He will have charge of all matters pertaining to the operation of the system and reports to Mr. Mellen, thus acting as his right-hand man in managing the general operative departments of the road. At present he is engaged in the revaluation of the entire property of the New Haven Road. This work will be completed by Aug. 1, when Mr. Stevens takes up his duties as a vice-president, with offices in New York City.

MR. H. GILLAM, formerly with the Westinghouse Company, has been appointed electrical superintendent of the New York, New Haven & Hartford Railroad, with headquarters at Stamford, Conn. He will have general jurisdiction over the maintenance and operation of electric transmission lines, with accessories, power houses and electric locomotives of the New York division. Mr. C. L. Peterson has been appointed chief engineer of the power station, in charge of the operation of the maintenance of station equipment, and Mr. J. C. Welch has been appointed to have charge of the maintenance and operation of electric locomotives.

Trade Publications.

H. B. CAMP COMPANY has issued a large and tasteful card folder illustrative of the use of its clay conduits at Charleroi, Belgium, on a handsome thoroughfare.

WATT-HOUR METERS.—High-tongue induction type watt-hour meters for single-phase work are fully described in Bulletin No. 4498 of the General Electric Company.

AUTOMATIC TIME SWITCH.—Leslie C. Dorland & Company, Poughkeepsie, N. Y., devote a pamphlet to a description of the Dorland automatic time switch. The switch is illustrated in detail and instructions for its operation are included.

TANTALUM LAMPS.—The tantalum lamp, having a specific power consumption of 2 watts per candle, with an average useful life of 700 hours on direct current, is described in detail in Bulletin No. 4451 of the General Electric Company.

INSULATING MATERIAL.—The Massachusetts Chemical Company has issued a loose-leaf catalogue and price list of insulating materials, including liquids and compounds, tapes and molded rubber goods. A special publication of the same company gives specific instructions for insulating armatures and field coils.

PAISTE APPLIANCES.—Bulletin No. 45 (July, 1907) of H. T. Paiste & Company, Philadelphia, contains an instructive article on electric light wiring, including hints as to the color of fittings in show windows. Elsewhere the bulletin describes and illustrates the Paiste "Pony" rosettes, panel cut-outs and entrance switches and switch-boxes.

LOCUST PINS.—The F. Bissell Company, Toledo, Ohio, has issued a circular entitled the "King Pin," which sets forth the advantages of the locust pin. A table is given of tests made by the Forest Service of the United States Department of Agriculture, showing that the locust pin is much superior in strength to oak, elm and birch pins tested in comparison.

STEAM SPECIALTIES.—In issuing a pamphlet to review briefly some of its more important lines of valves, fittings and special appliances, the Crane Company, Chicago, Ill., announces that a revised complete pocket catalogue showing its entire line of manufacture is in course of preparation and will be furnished as soon as possible after completion.

SINGLE-PHASE MOTORS.—The Advance Electric Company, St. Louis, describes in Bulletin No. 3 its new type of single-phase motor. The rotor has two sets of windings, one consisting of bare copper bars embedded in the core and short-circuited, and the other an insulated winding near the surface of the core, which is connected with a commutator which is short-circuited through a set of brushes.

DATA ON INSULATING MATERIALS.—With this title the Dielectric Manufacturing Company, of St. Louis, has issued a bulletin giving a large number of curves showing the dielectric strength of various insulating materials under normal and other conditions. The pamphlet includes a talk by Mr. J. J. Kessler to the salesmen of one of the companies handling Dielectric products which is a model of commercial exposition of a technical subject.

TUNGSTEN LAMPS.—Bulletin No. 4504 of the General Electric Company, Schenectady, N. Y., deals with the tungsten filament lamp for street lighting. The lamps are designed for either 40 or 50 cp for e. m. f.'s ranging from 7.2 to 20.25, and are intended for operation in series. The specific power consumption varies from 1.25 to 1.5 watts per candle. The life is estimated at 1000 hours, during which time the saving over a 3.5-watt carbon lamp would be 88 kw-hours per lamp.

WIRE MARKET NEWS.—The June issue of the "Wire Market News," published by the Western Wire Sales Company, of Chicago, Ill., contains several interesting articles on copper and the copper situation; statistics bearing on the copper metal supply, estimated increase in copper for 1907, etc. There are also two articles, one on "Why it costs more to roll 26-cent copper than cheaper material," and the other "Revolution in underground transmission work." The latter article fully describes the invention of Mr. Oliver T. Hungerford, to obviate conduits for underground work.

GRAPHITIZED FILAMENT LAMP.—The General Electric Company, Schenectady, N. Y., has issued Bulletin No. 4506, descriptive of the Gem 50-watt, 20-cp lamp. The filament is obtained from the ordinary carbon filament by subjecting it to the intense heat of the electric furnace. This operation (twice repeated) renders the filament more re-

fractory and capable of withstanding a materially higher temperature for a given life and deterioration. The higher temperature thus permitted gives increased lighting efficiency with a saving of 20 per cent in the specific power consumption over that required by the ordinary carbon filament lamps.

RAILWAY INVESTMENTS.—The Moody Corporation, which issues "Moody's Manual," has just brought out "American Railways as Investments," by Carl Snyder. This book is designed for the use of investment buyers, bankers and brokers. There is an elaborate introduction, dealing in the simplest and clearest manner with the whole subject of railway investment. The main body of the book is devoted to separate analyses of the important railway companies, including 90 per cent of the total trackage of the United States and Canada. The chapters on each railroad follow the same general scheme of analysis, so that comparisons can be made quickly and accurately. Mr. Snyder is well known as a scientific writer, and his recent book on "The World Machine," summing up present astronomy and knowledge of the physical universe, has excited a great amount of well-deserved attention and praise.

FEED WATER HEATERS.—A booklet summarizing what a Cochrane feed-water heater is and what it does, is being distributed by the Harrison Safety Boiler Works, of Philadelphia. It shows that the Cochrane open feed-water heater will often save about 16 per cent of the coal bill, one-sixth of the water bill, improve the quality of the boiler feed supply, and increase the capacity of the boilers by one-sixth and supply hot water, not only for boiler feeding, but also for other purposes about industrial plants, as washing, dyeing etc. Examples are given of applications at coal mines, paper mills, in condensing and non-condensing plants, and in steam power plants generally. The Cochrane oil separators, which make it possible to use exhaust steam for every purpose to which live steam of the same temperature could be applied, as for heating and drying, are also described and illustrated. To those who are interested, the Harrison Safety Boiler Works will supply more detailed information relating to the special conditions involved, and showing the saving to be expected in any particular plant.

RHEOSTAT SWITCHES.—Electrically operated ratchet driven rheostat switches have several advantages. In Bulletin No. 4510 recently issued by the transformer department of the General Electric Company, New York, these advantages are pointed out, and a description given of a simple, compact and efficient form of rheostat switch now being placed on the market. The switch is operated by a single-pole, double-throw knife switch on the switchboard. The switch arm is mounted on the axle of a wheel with a knurled rim and rotated by means of pawls, which engage the rim of the wheel. A core actuated by two solenoids moves the pawls to the right or left, depending upon which solenoid is energized, and the solenoids are connected directly to the double-throw knife switch on the switchboard. Means are provided to automatically make and break the circuit and thereby maintain a continuous step-by-step motion as long as the knife switch is closed, and automatic stops prevent running over after the switch arm has arrived at the end of its travel.

Business Notes.

THE ATLAS ENGINE WORKS have appointed Mr. Otto Dreckmann, Jr., as manager of their direct sales office at St. Louis, with offices in the Chemical Building.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, Pa., has changed its Chicago office and will hereafter be represented in that city by the Minerallac Company, 839 Monadnock Block.

ROTH BROTHERS & COMPANY, manufacturers of dynamos, motors and special electrical machinery, with headquarters in Chicago, have opened an office at the Electrical Exchange Building, 136 Liberty Street, New York, with Mr. George F. Schminke as manager.

THE PHOENIX GLASS COMPANY, of Pittsburg, New York and Chicago, is distributing to its friends a very attractive silver watch fob, embodying the handsome design on the one side of a Phoenix rising from the ashes and on the other side the name and address of the company.

WHITE STAR OIL FILTERS continue in brisk demand, and this fact proves to the Pittsburgh Gauge & Supply Company, Pittsburgh, Pa., that prosperity still shows no sign of a let-up. Among concerns that have purchased these filters the past month are the following: Walter Baker Company, Boston, Mass.; Union Ice Company, Quinnimont, W. Va.; Canton Home Brewing Company, Canton, Ohio; American Cast Iron Pipe Company, Birmingham, Ala.; Pittsburgh-Buffalo Company, Burgettstown, Pa.; Anniston Fertilizer Company, Anniston, Ala.; Ivanhoe Furnace Company, Ivanhoe, Va.; Atlantic Suburban Electric Company, Atlantic City, N. J.; Taunton-New Bedford Copper Company, New Bedford, Mass.; Schenley Hotel, Pittsburgh, Pa.; West Virginia Brewing Company, Central City, W. Va.; Southern Steel Company, Ensley, Ala.; Crystal Laundry Company, Cumberland, Md.; Tennessee Coal, Iron & Railroad Company, Ensley, Ala.; Columbian Canning Company, Lubec, Maine; Flynn Lumber Company, Swiss, W. Va.; McGhee Lumber Company, Dallas, Fla.; Alton Paving, B. & F. B. Company, Alton, Ill.; Evansville Brewing Association, Evansville, Ind.; Electrical Development Company, Niagara Falls, Ont.; Jond Westwick & Son, Galena, Ill.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 16, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

859,909. TELEPHONE ATTACHMENT; Arne H. Berg, Clarkfield, Minn. App. filed April 23, 1907. In a device of the character described, a telephone hook, and a mechanically operated signal, adapted to be actuated when the receiver is removed from said hook.

859,923. ELECTRIC CONDENSER; Clarence Z. Davis, Buffalo N. Y. App. filed May 13, 1907. Relates to construction of condenser having strips of tinfoil in the form of a roll and sheet metal strips forming clamps to hold the same at the ends thereof.

850,948. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 15, 1906. Relates to a form of receiver for telegraph instruments making use of a hot wire. Operates similar to what has been used in telephony. Employs a recording tape.

859,949. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 23, 1906. Provides an instrument, such as a siphon recorder, for the purpose of either receiving transmitted impulses by sound or relaying the same to other lines.

859,950. SYSTEM FOR AUTOMATIC SIGNALING; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 11, 1907. Covers improvements in systems for automatic signaling and more especially for signaling in connection with railways to enable crews of trains or cars traveling either in the same or opposite directions to readily determine the location of each other with respect to the danger zone.

860,001. SHIP'S TELEGRAPHY; Richard D. White, Washington, D. C. App. filed Aug. 2, 1906. Means whereby a single operator can telegraph to a number of gun's crews, details as to ranges and deflections, to provide for which the sights should be set, and in which the signal to each particular gun shall be repeated at a central station.

860,014. OUTLET-BOX; William H. Colgan, Newton, Mass. App. filed Jan. 26, 1907. Construction of outlet or wall box by which the conduit may be locked to the wall of the box or plate and held against rearward dislocation.

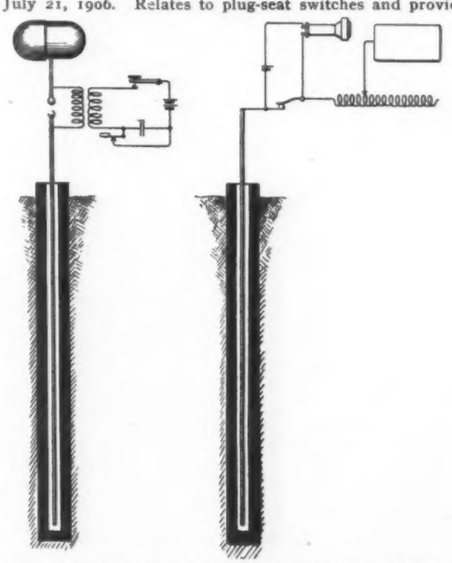
860,016. SUBSTATION-PROTECTOR. A single piece of insulating material provided with a bore, an inclosed fuse carried within the said bore and provided with suitable terminals, a thermal protector and a lightning arrester inserted into the said piece of insulating material and electrically connected with one terminal of the fuse.

860,025. GUARD FOR THE MOUTHPIECES OF TELEPHONE-TRANSMITTERS; Gerhardt E. Grimm, Philadelphia, Pa. Filed May 26, 1906. A telephone guard, comprising a strip or plate bent intermediate its ends to provide a cylindrical housing at one end of the guard, the leaves of the strip or plate having registering openings, and means for securing the guard in place on the mouthpiece of a transmitter.

860,051. CONSTRUCTING ANTENNÆ OF WIRELESS TELEGRAPHY; Joseph Murgas, Wilkes-Barre, Pa. App. filed Feb. 17, 1906. A wireless telegraph station comprising a wave apparatus and an antenna connected to the wave apparatus between the apparatus and the earth, extending into the earth and insulated from the latter.

860,057. ELECTRIC TERMINAL; George D. Pogue, St. Louis, Mo. App. filed Nov. 22, 1906. Has clamping jaws and a terminal with a fastening device, and a plate between said jaws and provided with an opening for the passage of said fastening device, and a flange carried by said plate and closing the opening in said jaws.

860,070. PLUG-SEAT SWITCH; Ernest E. Yaxley, Chicago, Ill. App. filed July 21, 1906. Relates to plug-seat switches and provides a bell-



860,051.—Constructing Antennæ of Wireless Telegraphy.

crank lever pivoted at its elbow, one end of the lever being operated by the plug.

860,072. MEANS FOR REMOVING ICE FROM TROLLEY WIRES; Charles E. Atkinson, Richmond, Ind. App. filed Jan. 8, 1906. Mechanical construction for expeditiously removing electrical impediments from line wires employed in carrying electrical currents in the propulsion of electrical vehicles where a direct contact is necessary at all points along the line.

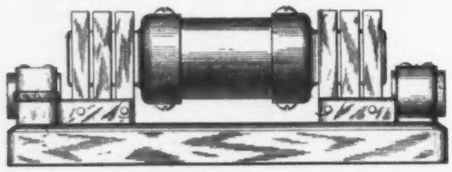
860,104. AUTOMATIC STARTER FOR ELECTRIC MOTORS; William C. O'Brien, Baltimore, Md. App. filed April 19, 1905. An automatic starter for an electric motor making use of a solenoid operated arm which trips a row of contactors into successive operation.

860,114. TROLLEY HARP; Charles E. Atkinson, Richmond, Ind. App. filed Oct. 20, 1906. The trolley harp is made in the form of a separate section pivoted to have a vertical oscillatory movement at the upper end of the pole.

860,117. BASE-FASTENING DEVICE FOR ELECTRICAL APPARATUS; Louis Bates, Hoboken, N. J. App. filed July 9, 1906. Has means for preventing the accidental formation of an arc on the back of the non-conductive base of a switch. The cavities for the various fastening devices do not extend clear through the base.

860,124. SWITCH; Donald M. Bliss, Brookline, Mass. App. filed July 14, 1905. Relates to an induction motor of the single-phase type, in which the motor is rendered self-starting by means of phase displacement.

860,132. SIGNAL-DROP; Henry J. Heeney, Boston, Mass. App. filed Sept. 17, 1906. Relates to a signal drop of the kind commonly used



860,057.—Electric Terminal.

in connection with telephone switchboards, and aims to provide a drop which cannot be accidentally operated by shocks or vibrations.

860,153. LAMP-SOCKET; Robert Rowley, New York, N. Y. App. filed April 13, 1906. Has an electromagnetically operated switch within the socket whereby the lamp may be operated from a distant point.

860,157. LIGHTNING-ARRESTING SWITCH; Washington D. Shirk, Fairfield, Iowa. App. filed Feb. 28, 1906. Form of lightning arrester switch having carbons with relatively large surfaces to afford a free escape of excessive currents and at the same time minimize the possibility of any injury being done.

860,163. SIGNAL FOR PRESSURE-GAUGES; John B. Townsend, Wellford, W. Va. App. filed Jan. 29, 1907. Details of construction of a pressure gauge switch having a contact roller engaged by an interrupted contacting roller surface.

860,175. TELEPHONE SYSTEM; David H. Wilson, Chicago, Ill. App. filed Oct. 29, 1904. A telephone system comprising a series of telephone instruments, a bridge circuit associated with each intrument and normally open when the talking circuit is completed, and means in the circuit of each telephone instrument for automatically closing the bridge circuit during the signaling operation.

860,179. ELECTRIC HEATER; Edward H. Abbott, Los Angeles, Cal. App. filed Dec. 19, 1905. Features of construction of a heater having a cylindrical casing with vertical insulating tubes spirally wrapped with resistance wire. The circulation of air through the tubes keeps the resistance element cool.

860,195. STORAGE-BATTERY ELECTRODE; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed April 28, 1905. An electrode unit for alkaline storage batteries, comprising a perforated tubular longitudinally corrugated metallic insoluble inclosing pocket, having active material therein under elastic pressure and affording the entire support for the active material, substantially as set forth.

860,206. ALARM AND SIGNAL MECHANISM; Ellsworth E. Flora and Robert J. Zorge, Chicago, Ill. App. filed Oct. 11, 1906. Provides means which will position a torpedo in the path of a train when a switch is left in improper relation.

860,229. TROLLEY STAND; James H. McPherson, Haverhill, Mass. App. filed Jan. 31, 1907. Provides a form of trolley stand in which the upward pressure caused by the lifting spring upon the trolley wheel is decreased as the pole is lowered. Has means for adjusting the leverage through which the spring acts so that it may be caused to exert its maximum effect in pressing the trolley wheel upward while in a predetermined position and to exert its minimum effect of pressing it upward in another position.

860,291. STORAGE BATTERY; William Gardiner, Chicago, Ill. App. filed May 20, 1905. Construction of storage battery plate in which the maximum area of active material is presented to the action of the battery solution without allowing the loose articles to settle into the bottom of the cell. Has U-shaped perforated lead plates bent together and filled with active material.

860,305. ELECTRIC-CURRENT REGULATOR; David R. Knapp, Philadelphia, Pa., and Howard E. Cade, Pencoyd, Pa. App. filed Nov. 24, 1905. Details of apparatus for automatically controlling and regulating the charging and discharging voltage of a storage battery.

860,362. LAMP-HOLDER; William J. Phelps, Detroit, Mich. App. filed Dec. 20, 1902. Construction of lamp-holder adapted for supporting ordinary lamps, but which is particularly adapted for use in connection with turn-down lamps in which devices for modifying the flow of current to the separate filaments of the lamp are carried by the holder itself and actuated by the ordinary switch key.

860,360. PLUG-SWITCH; Earl C. Eldredge, Springfield, Mass. App. filed July 27, 1906. Features of improvement of a plug-switch adapted for automobiles having a battery and magneto generator as alternative sources of current.

860,432. ELECTRIC SWITCH; Johan M. Andersen, Boston, Mass. App. filed Oct. 13, 1905. A switch having its different parts standardized so that different forms of switches may be made from the same parts at a minimum cost and without decreasing the efficiency of the switches.

860,433. OPERATING MECHANISM FOR ELECTRIC SWITCHES; Johan M. Andersen, Boston, Mass. App. filed March 30, 1907. Apparatus for operating the movable member of substantially large electric switches, such as are impelled in circuits carrying high-tension currents.

860,442. FIRE ALARM; Eugene Bucci and Quirino Cicchetti, Boston, Mass. App. filed Dec. 3, 1906. Has a spring impelled member normally restrained by a flexible strip of fusible material which melts or stretches under undue heat.

860,469. BRANCH BOX; Morton Havens, Jr., Albany, N. Y. App. filed March 24, 1906. Construction of branch box for electric wires, particularly applicable for exposed conduit work. Has a cast iron end with lugs into which may be screwed the fastening devices of an insulating plate or cover.

860,477. METHOD OF AND MEANS FOR CHARGING ELECTRIC FURNACES; William H. Huffman, Niagara Falls, N. Y. App. filed Feb. 15, 1907. A means for charging electric furnaces having flexible and rigid walls separating the raw material to be treated from the surrounding embedding mixture.

860,481. ELECTRIC CUT-OUT; Everett O. Jackson, Stillwell, Ill. App. filed Feb. 6, 1907. A cut-out comprising a loop arranged in the grounded conductor, a spring member forming a part of the service conductor, and means for normally maintaining said spring member to form a continuation of the service conductor.

860,482. CONTACT PLUG FOR SOCKETS FOR ELECTRIC LAMP; Frederick W. Jaeger and Gustav A. Landsee, Milwaukee, Wis. App. filed May 4, 1906. Provides a contact plug having screw-threaded members provided with spring arms and means adapted to be manually actuated for spreading said plug members, and an automatically retained contact plunger co-operating with said screw-threaded members.

860,525. TROLLEY-WIRE HANGER; Walter G. Clark, New York, N. Y. App. filed June 20, 1906. Covers improvements in hanging or suspending devices for overhead trolley wires, and particularly to that class known as the double-catenary suspension. Construction in which the side bars and spreader bar of the hanger are easily adjustable so that it can be quickly made to fit varying conditions.

860,532. CIRCUIT-CLOSING DEVICE; Roy C. Cram, Bridgeport, and Charles L. Graves, Milford, Conn. App. filed Aug. 2, 1906. A switch having a pivoted switch arm and adapted to hang vertically and normally so held by yielding means. Has one or more switch levers weighted at one end with liquid retarding means therefor.

860,560. AUTOMATIC FIRE-EXTINGUISHER SUPERVISORY SYSTEM; James G. Nolen, Chicago, Ill. App. filed Sept. 11, 1902. Relates to automatic fire-extinguisher supervisory systems and has means whereby the supervision may be obtained from a plurality of such systems by a central station in order that they may be maintained constantly in effective condition.

860,561. ART OF RAILWAY SIGNALING; Wesley T. Obiatt, Stratford, and Edward F. Latimer and William Grunow, Jr., Bridgeport, Conn. App. filed Aug. 2, 1906. System for effecting the movement of railway cars or trains over a railway either in the same or opposite directions, whereby cars or trains may enter a definite section of the roadway from either end thereof and in any desired number, the first car to enter such section effecting the operation of signals at both ends of the section giving definite indication, and the suceeding cars giving additional indications to show the number thereof.

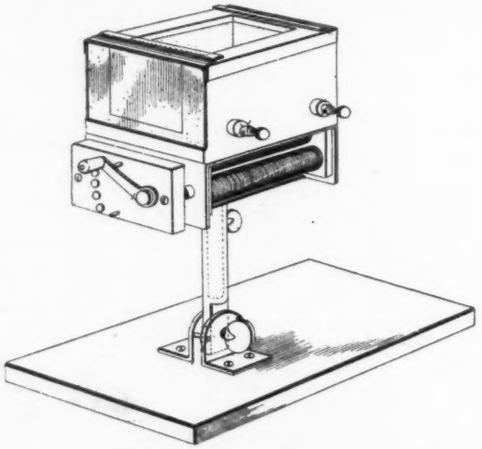
860,568. ELECTRIC INCANDESCENT LAMP AND CONNECTION THEREFOR; William J. Phelps, Detroit, Mich. App. filed Sept. 10, 1902. An electric incandescent lamp provided with a base having terminals for the reception of current from a suitable lamp-holder, said base having coupling devices about its outer normally projecting end, said coupling devices being electrically connected with the lamp terminals.

860,572. MEANS FOR CONTROLLING ELECTRIC-CURRENT-DISTRIBUTING SYSTEMS; Joseph L. Routin, Lyons, France. App. filed Dec. 15, 1905. A special arrangement for use in cases where a plurality of generators in parallel supply alternating currents, and by which periodical oscillations or hunting of the regulating mechanism is prevented.

860,587. ELECTRIC FURNACE; Ross C. Unger, Cleveland, Ohio. App. filed July 25, 1906. An electrical furnace comprising a casing having refractory linings and a granular resistance material located on the bottom of the furnace and having a slab of refractory material for retaining such resistance material in place.

860,601. ARRANGEMENT OF THE FILAMENT FOR HIGH-VOLTAGE INCANDESCENT ELECTRIC LAMPS OF HIGH EFFICIENCY; Carl Glogau, Stuttgart, Germany. App. filed May 17, 1907. Construction of support for tantalum filaments.

860,605. FIRE-PROTECTION SYSTEM; James G. Nolen, Chicago, Ill. App. filed Sept. 17, 1904. A fire-protection system having means in conjunction with a fluid receptacle whereby different conditions of



860,587.—Electric Furnace.

pressure exist under different circumstances, and means controlled by the pressure for giving or transmitting alarms or signals upon the establishment of certain pressure conditions of the system.

860,606. SAFETY-FUSE; Franz Oprendek, Vienna, Austria-Hungary. App. filed Sept. 12, 1905. Improvements in safety fuses of the kind in which an asbestos cord is provided with a rapidly conducting and easily fusible material and passed around two contact pins so that a fresh piece of cord may be drawn into place whenever desired.

12,672. ELECTROLYTIC CELL; George A. Gabriel, New York, N. Y. App. filed May 29, 1906. A continuous anode for electrolytic cells having horizontal and vertical passages therein for the circulation of the electrolyte and cavities of substantially similar outline located adjacent the aforesaid active faces of said anode.